Environment Canada Environnement Canada

BIRD TRENDS

A report on results of national ornithological surveys in Canada

Number 10, Winter 2009

Canada

ISSN 1185-5967

Number 10, Winter 2009
Editor:
Martin Damus

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This issue of *Bird Trends* focuses on information about trends in waterfowl (ducks, geese, and swans) and other waterbirds (a group that includes loons, grebes, pelicans, cormorants, herons, bitterns, rails, coots, and cranes). Some articles focus on a selection of trends of particular interest or on ways of measuring them, such as the evolution of waterfowl surveys in Quebec, the continuing growth in abundance and range of temperate-nesting Canada Geese in southern Ontario, a method for estimating mortality of seabirds due to marine oil pollution, changing trends in the harvest of ducks by waterfowl hunters, and the growth of nesting colonies of Common Eiders in Labrador.

Other articles describe the results of directed management and its success in affecting population trends, such as attempts to control the rapid growth in abundance of Greater Snow Geese, to improve conditions for colonial waterbirds nesting on islands in Hamilton Harbour and for Common Terns nesting at Port Colbourne, and to manage the growth of Double-crested Cormorants in the Great Lakes. In these cases, the management attempts have met with mixed success, and most indicate that intensive efforts must be continued in the long term to maintain the desired benefits. In all cases, the clear benefits of long-term commitment to monitoring programs are demonstrated.

Inside:

***Bird Trends* is available on-line at:**
http://www.cws-scf.ec.gc.ca/birds/news/index_e.cfm

Waterfowl monitoring in Quebec

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In Quebec, the Canadian Wildlife Service has, since 1990, conducted an annual survey of waterfowl breeding in the boreal forest. The territory covered in this helicopter survey (Figs. 1 and 2) runs roughly from the Laurentian foothills north to Lac Mistassini and the Réservoir Manic-Cinq and from Abitibi east to Natashquan, a total area of 540 000 km^2 (Canadian Wildlife Service 1996; Lepage and Bordage 2003). A large portion of southern Quebec — specifically, the St. Lawrence Valley — has thus remained unsurveyed. The need for knowledge on waterfowl in the St. Lawrence Valley was evident. The last aerial waterfowl surveys covering all the banks of the St. Lawrence dated back to the 1970s (1974–1981) (Lehoux *et al.* 1985). Yet this region contains areas that are among the most diversified and most heavily used by waterfowl in all of Quebec. The majority of the province's human population is also concentrated in this region, so it is here that most conflicts with waterfowl populations arise. A widespread road network, intensive farming, constant marine traffic, numerous industries, and strong hunting pressure are all daily challenges for waterfowl in the St. Lawrence Valley.

To remedy this worrisome situation and effectively carry out some of its mandates (environmental assessments, hunting regulations, etc.), the Canadian Wildlife Service began, in 2004, to monitor

Figure 1. General location of the territory surveyed in southern Quebec.

waterfowl breeding pairs along the banks of the St. Lawrence River and its main tributaries, as well as in the St. Lawrence, Lac Saint-Jean, and Abitibi lowlands. The lowlands as a whole were systematically surveyed for the first time in 1998 and 1999 as part of the Eastern Lowlands Initiative, a joint project involving the Canadian Wildlife Service, Ducks Unlimited Canada, and the Ministère des Ressources Naturelles et de la Faune du Quebec (Maisonneuve et *al.* 2001). However, this lowlands survey was not part of an annual monitoring program.

To monitor waterfowl breeding pairs along the banks of the St. Lawrence River and its main tributaries, we first identified, with topographical maps, all the 1-km^2 (1 km × 1 km) that touch the banks of the St. Lawrence River (from Cornwall to Natashquan on the north shore and to Restigouche in the Baie des Chaleurs on the south shore), the Ottawa River, the Rivière Richelieu, the Saguenay River, and Lac Saint-Jean. The shores of islands are included in the study area, except those of the Îles de la Madeleine, which are excluded because of the high cost of studying this isolated region. The total study area along the St. Lawrence and its three tributaries is approximately 7300 km^2. We randomly selected 212 transects of 10 km in length in the three sections of the St. Lawrence: river, estuary, and gulf. Half of these transects are surveyed annually by helicopter (Fig. 2).

In April and May 2004, the "inaugural" monitoring revealed that waterfowl are highly abundant at this time of the year in the St. Lawrence region. Although the survey targets pairs that breed locally on the shores, several groups of birds are still migrating, which represents a considerable challenge when the helicopter flies through. Fortunately, when compiling the results, we apply a breeding pair factor to rule out migratory individuals. The diversity of breeding waterfowl observed varies according to the section of the St. Lawrence surveyed. For example, the Mallard (*Anas platyrhynchos*), Gadwall (*A. strepera*), Northern Pintail (*A. acuta*), and Wood Duck (*Aix sponsa*) are typically found in the river fluvial section, whereas the Common Eider (*Somateria mollissima*), American Black Duck (*Anas rubripes*), and Common Merganser (*Mergus merganser*) prefer the estuary and gulf sections.

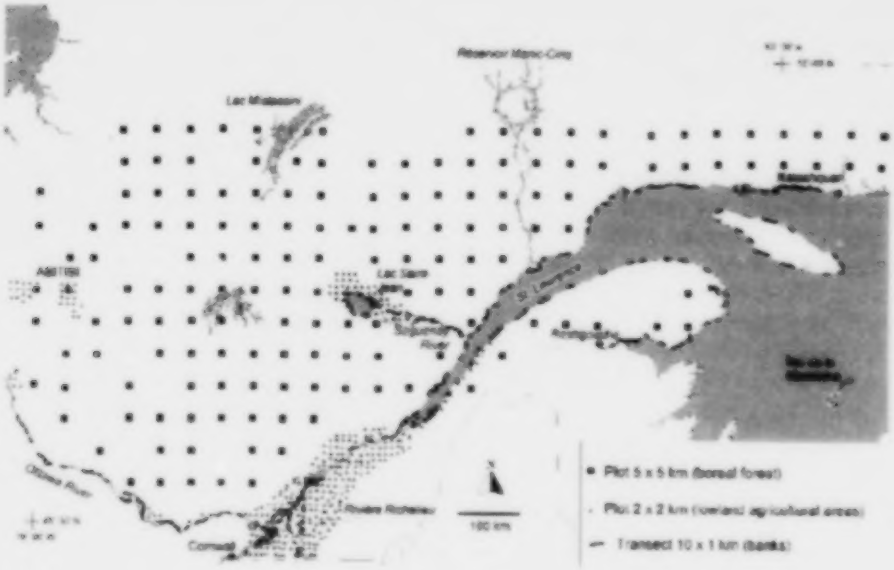

Figure 2. Location of the three annual waterfowl monitoring studies conducted by the Canadian Wildlife Service in southern Quebec.

For monitoring breeding pairs in the lowlands (farming area) of the St. Lawrence, Lac Saint-Jean, and Abitibi, we established the study area at approximately 39 000 km^2. In 1998 and 1999, 343 plots measuring 2 km × 2 km were systematically positioned every 50 km on topographical maps. To cover all the lowlands for the new monitoring study, 200 plots were randomly selected from the 343 plots surveyed in 1998 or 1999. Once again, only half of these 200 plots are surveyed annually by helicopter (Fig. 2). In spring 2004, the "initial" monitoring clearly showed that watercourses in farming areas (streams, ponds, rivers, etc.), even where farming is intensive, are good nesting habitats for the Mallard, American Black Duck, and Green-winged Teal (*Anas crecca*).

In addition to the already well-established monitoring in the boreal forest, the two new waterfowl monitoring studies launched in spring 2004 should enable biologists to identify the long-term trends and to estimate population numbers for waterfowl that breed in the south of the province. All waterfowl in southern Quebec will now be under surveillance, for the benefit of wildlife watchers and users alike.

To learn more

Visit the Canadian Wildlife Service – Quebec Region waterfowl website (http://www.qc.ec.gc.ca/faune/sauvagine/html/waterfowl.html), which now provides data on waterfowl monitoring in the boreal forest and which will be updated with data on waterfowl monitoring on the banks of the St. Lawrence River and its main tributaries and in the St. Lawrence, Lac Saint-Jean, and Abitibi lowlands.

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The rise of temperate-breeding Canada Geese in Ontario

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The number of Canada Geese (*Branta canadensis*) in southern Ontario has increased dramatically over the past few decades. Canada Geese, once regarded universally as a symbol of the northern wilds and a harbinger of the changing seasons, have become, in the eyes of many, a problem to be dealt with. While portions of at least four Canada Goose populations are present at various times of year in southern Ontario, the recent increase in goose numbers is due principally to the rise of the temperate-breeding population. Temperate-breeding Canada Geese are sometimes referred to as "resident" geese because of their tendency to spend most or even all of the year in one location. In Ontario, these geese nest primarily south of 47°N latitude, with a few isolated breeding populations as far north as 49°N, mostly along the shores of the upper Great Lakes. The name "resident" is somewhat of a misnomer, because, like their sub-Arctic-breeding brethren, geese breeding in southern Ontario do migrate south when winter conditions make it difficult to find food or open water. Their migrations are just shorter and less predictable. Also, many subadults and failed breeders migrate north to the James Bay coast or beyond each summer to moult.

A brief history of temperate-breeding Canada Geese in Ontario

Archaeological evidence and historical accounts tell us that prior to European colonization, Giant Canada Geese (*B. c. maxima*) nested in southwestern Ontario (Lumsden 1981). The historical nesting range in Ontario was probably limited to prairie areas in the extreme southwest, because much of the rest of the province was completely forested. Early settlers harvested geese and their eggs for food, leading to a decline in their numbers; as a result of uncontrolled hunting, they were virtually extirpated by the late 1800s. In the early 1900s, Canada Geese were held privately by aviculturists in southwestern Ontario for hobby or breeding, by others

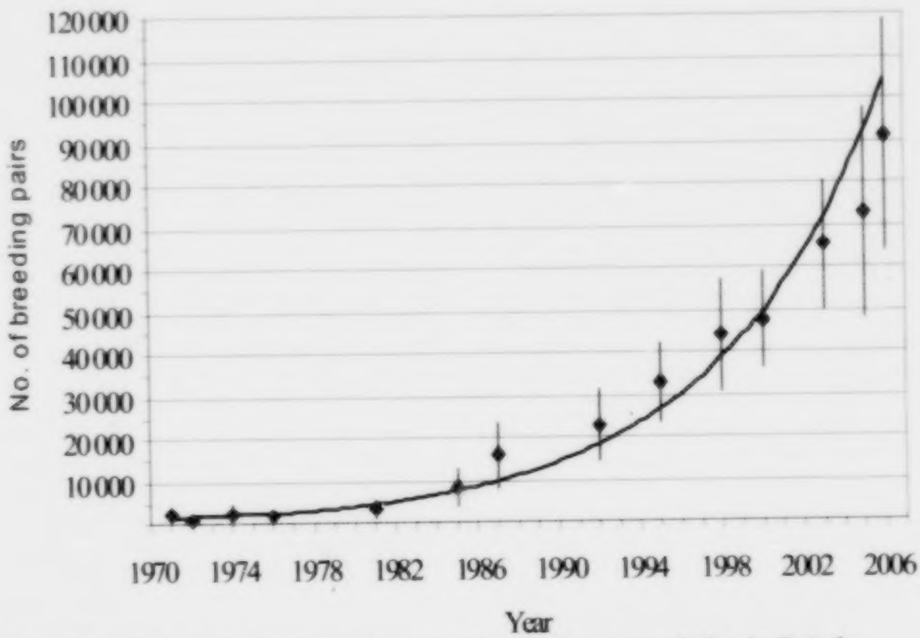

Figure 3. Growth of the temperate-breeding Canada Goose population in Ontario, 1971–2006.

as decoy flocks, and by some occasionally for food. The young produced were sometimes allowed to fly free, and some small wild nesting populations developed. Beginning in the 1950s, Ontario game managers began a deliberate effort to reintroduce breeding Canada Geese to southern Ontario. By the early 1960s, there were perhaps 1000 wild Canada Geese. In 1968, the Ontario Ministry of Natural Resources began a more formal restoration program for southwestern Ontario, with the goal of establishing a self-sustaining nesting population of Canada Geese to enhance goose hunting opportunities and to provide viewing and non-consumptive recreational opportunities. By the late 1970s, the number of geese along the Toronto waterfront had increased to a point where they were becoming a nuisance. At first, this was not considered a serious problem, since the geese could be relocated elsewhere in Ontario to further the goals of the reintroduction program. During the 1980s, Toronto waterfront birds were shipped throughout Ontario, including the north shores of Lake Huron, Lake Superior, and the Rainy River area. Hunting seasons for Canada Geese were closed in some areas to allow the local flocks to become established.

Canada Geese have flourished in southern Ontario since reintroduction. In contrast to the Arctic and sub-Arctic regions where other Canada Goose populations breed, environmental conditions in the temperate zone are relatively stable, and geese breed successfully year in and year out. Even more importantly, the southern Ontario landscape has undergone dramatic change in the years between the disappearance of the original breeding geese and the reintroduction of the temperate-breeding Canada Goose population. By clearing the land of most of its forests and planting crops, by creating large fertilized grassy areas such as parks and golf courses adjacent to water bodies, and by removing natural predators from the landscape, we have created a virtual paradise for geese.

In 1971, the Canadian Wildlife Service introduced a ground-based waterfowl breeding pair survey covering most of the province south of 46°N. This survey provided managers with the first

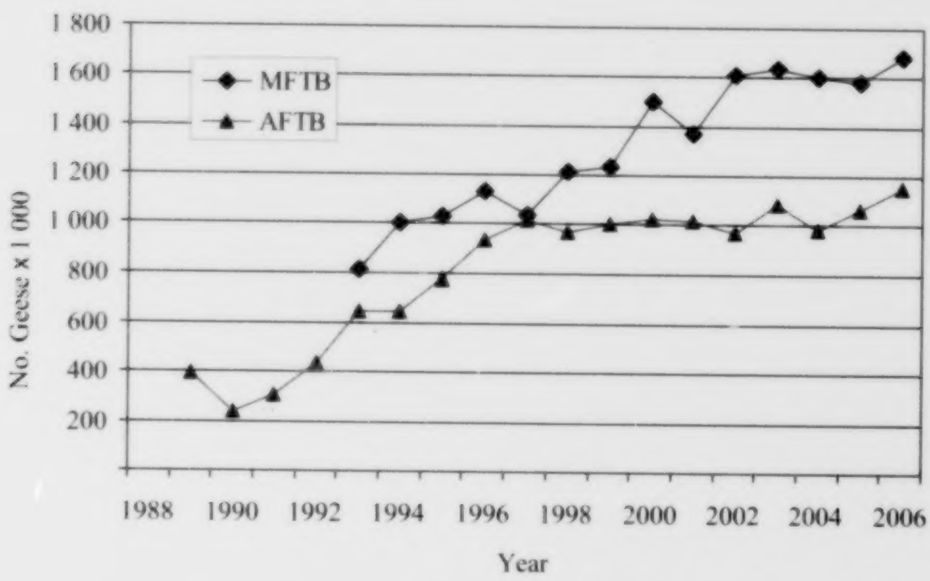

Figure 4. Recent growth of the Mississippi Flyway (MFTB) and Atlantic Flyway (AFTB) populations of temperate-breeding Canada Geese.

opportunity to scientifically evaluate the number of temperate-breeding geese. The survey involves visiting, on the ground, about 350 0.65-km^2 plots; it has been conducted periodically (roughly every 3 years) since its inception. During the 1970s, the low numbers of geese meant that the precision of the survey results was poor, and breeding pair estimates ranged from about 750 to 2400 with no discernible trend. As the number of geese increased, the precision of the survey improved. During the 1980s and early 1990s, the population grew rapidly from an estimated 3400 pairs in 1981 to 23 000 pairs in 1992.

The current situation

The long-term data series reveals a pattern of exponential population growth (Fig. 3). By 2006, the population had surpassed 91 000 breeding pairs. Since 1971, the average annual growth rate has been about 13%; at this rate, the population doubles about every 6 years. Because geese from several populations mix together during migration and wintering, the only way the size of distinct populations can be monitored is by counting breeding pairs during the nesting season. However, even breeding pair surveys have limitations. Not all geese in a population may be present on the breeding grounds at any given time. Canada Geese are long-lived animals, and they begin breeding only in their second or third year. Subadults often travel north to moult during the breeding season. Also, each year, either some proportion of the mature breeding birds do not nest, perhaps because they do not have the energy reserves needed to produce a clutch of eggs, or their nesting attempt fails due to a predator, flooding, or some other form of disturbance. Many of these failed breeders join the subadults at northern moulting areas. Non-breeding birds represent a substantial portion of the total population in any given year. Furthermore, temperate-breeding geese lay large clutches and in most years produce large numbers of offspring. The total population size must thus be derived by knowing the number of breeding pairs in a given year and either knowing or estimating the values of a series of other population parameters, such as annual survival rate, average age of first breeding, breeding propensity, average clutch size, and gosling survival rate. From banding data, Canadian Wildlife Service biologists can estimate the adult and first-year survival rates. Values of the other parameters can be estimated from nesting studies, anecdotal data, or data collected on similar populations. When all of the available information is combined, the estimated total spring population of temperate-breeding Canada Geese in Ontario in 2006 was roughly 430 000, and the total fall flight (including young-of-the-year) was a whopping 610 000 geese!

The recent rise of temperate-breeding geese is not unique to Ontario. Several other provinces and U.S. states also have large and growing populations. There are currently an estimated 1 million temperate-breeding Canada Geese in the U.S. states of the Atlantic Flyway and an additional 1.5 million in Mississippi Flyway states (U.S. Fish and Wildlife Service 2004) (Fig. 4). In addition to increasing in size, the Ontario population of temperate-breeding Canada Geese has also expanded its range. Since geese were reintroduced to southern Ontario, they have spread out from a few release sites to almost all areas of Ontario south of 46°N. In the 1970s, only 1–2% of the Canadian Wildlife Service ground survey plots had breeding pairs of Canada Geese; by 2003, this had increased to 22%. Nesting densities have also increased. Up until 1987, the highest nest density observed was 4.6 nests/km^2; by 2003, some plots had nesting densities of nearly 11 nests/km^2. Nesting densities are even higher in some urban areas. For instance, in the Greater Toronto Area, where Toronto and Region Conservation Authority staff monitor nesting geese for the purpose of oiling their eggs, nesting densities as high as 500 nests/km^2 have been observed in a 4-ha wetland in High Park (Moro 2004).

The rapid and sustained growth of temperate-breeding Canada Goose populations poses significant management challenges to biologists and managers in Ontario. As the number of temperate-breeding Canada Geese has

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grown, so has the incidence of conflicts with humans. For instance, city park users and cottage owners decry the droppings that geese leave on lawns and beaches, farmers suffer economic losses when large flocks of geese descend on winter wheat or other crops, and airport managers are becoming increasingly concerned about the risk that geese pose to aircraft.

Whether the population of temperate-breeding Canada Geese will stop growing any time soon is difficult to predict. In the meantime, the Canadian Wildlife Service is implementing management actions to mitigate the negative effects of the geese and slow population growth. Management strategies include producing outreach materials to help people deal with nuisance geese and issuing bird damage permits to allow the use of prohibited methods such as firearms to scare or kill geese that are causing damage or are a threat to public safety. Other permits authorize the oiling of eggs with non-toxic mineral oil to prevent hatching and the relocation of geese from certain areas. Finally, the Canadian Wildlife Service has introduced special hunting regulations to increase the harvest of temperate-breeding geese.

Looking at Figure 3, the three most recent data points are below the long-term curve. Could this mean that the population growth rate is slowing? Only time will tell.

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Atlantic Population Canada Goose population and productivity trends

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The Canada Goose (*Branta canadensis*) is the most widely distributed goose species in North America (Mowbray *et al.* 2002) and for conservation purposes is divided into management populations based on breeding and wintering areas (Dickson 2000). The northernmost breeding population of medium-sized Canada Geese is the Atlantic Population (hereafter AP; *B. c. interior*), which was recognized by the Atlantic Flyway Council as a single population in 1983 (Wyndham and Dickson 1995). The principal nesting area for this population is in Nunavik, Quebec's northern tundra region, whereas the major wintering areas are the Delmarva Peninsula of Chesapeake Bay (Maryland and Delaware) and parts of New York, New Jersey, Pennsylvania, and Virginia (Hindman *et al.* 2004a). Prior to 1996, this population was managed under the principles and objectives of the Atlantic Flyway Canada Goose Management Plan (Atlantic Flyway Council 1989). In 1996, however, in response to a sharp decline in numbers in the late 1980s and early 1990s, a specific plan for this population was developed, the Action Plan for the Atlantic Population of Canada Geese (Atlantic Flyway Council 1996). This new plan specified population objectives and strategies, such as survey and research needs, for the recovery of the population.

Population monitoring and trends 1955–1995

Beginning in 1955 and for the next almost 40 years, AP geese were surveyed only during winter. Geese from a number of populations mix with AP geese on wintering areas, in particular North Atlantic Population (*B. c. canadensis*) and temperate-breeding or "Resident Population" geese (mainly *B. c. maxima*) (Dickson 2000; Hindman et al. 2004b).

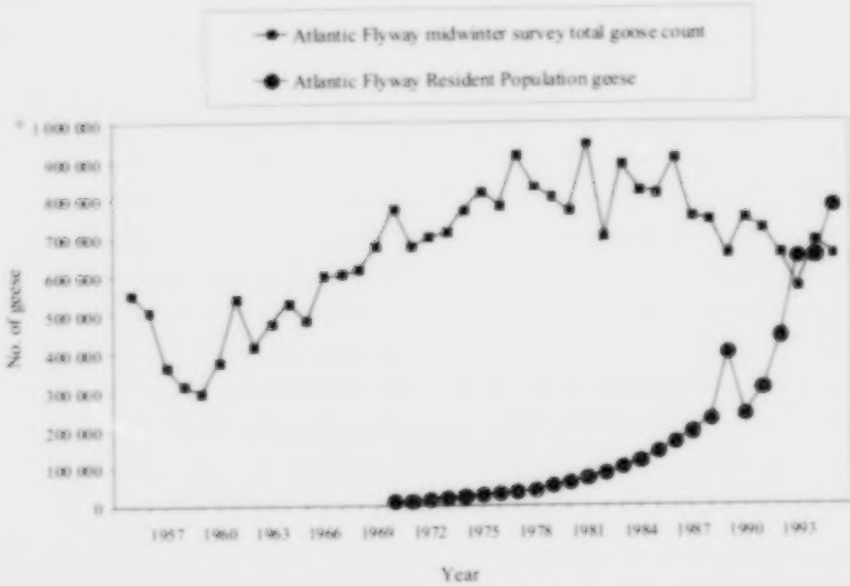


Figure 5. Estimated total number of Canada Geese (midwinter survey) and Resident Population Canada Geese (spring breeding surveys) in the Atlantic Flyway, 1955–1995.

Consequently, the midwinter surveys do not yield population estimates for any of the specific populations but instead provide a total Canada Goose count. For the first decade of the midwinter surveys, the number of Canada Geese in the Atlantic Flyway fluctuated between 300 000 and 600 000 birds (Fig. 5). Over the next two decades, the total wintering population increased steadily until, by the early 1980s, it was estimated to be close to 1 million birds (Serie and Raftovich 2002) (Fig. 5).

In the mid-1980s, however, numbers began to decline; by 1995, it was estimated that the total number of Canada Geese (migrants and resident birds) overwintering in the Atlantic Flyway was only 652 700 birds (Serie and Raftovich 2002). The decline caused great concern, because at the same time that the total number of geese was dropping, spring surveys of nesting pairs showed that the number of temperate-breeding geese in the flyway was increasing rapidly (Fig. 5). This led managers to the realization that the decline in AP geese was more serious than previously thought and prompted the development of a breeding ground survey.

Aerial surveys in the 1960s identified northern Quebec's Ungava region as the primary nesting area for AP geese (Kaczynski and Chamberlain 1968). In 1988, the U.S. Fish and Wildlife Service conducted an aerial breeding pair survey of four physiographic regions covering the breeding range of AP geese (Malecki and Trost 1990). The first three regions comprised the Ungava Peninsula — 1) inland tundra, 2) flat coastal tundra, and 3) taiga — whereas the fourth was the northern boreal forest (Fig. 6). This survey used a stratified sampling procedure, designed to generate an accurate estimate of the number of breeding pairs.

The first breeding pair survey produced an estimate of 157 000 pairs, with 90% from regions 1–3 (Malecki and Trost 1990). With the midwinter surveys showing a continued decline in Canada Goose numbers during the early 1990s, despite increasingly restrictive hunting regulations in the Atlantic Flyway states, a number of organizations — including the Canadian Wildlife Service, U.S. Fish and Wildlife Service, and James Bay Energy Corporation — funded a second aerial survey in 1993. This survey used a sampling technique similar to that used in

the 1988 survey, but was modified in order to be capable of detecting a 10% change in population size at a 95% confidence level (Bordage and Plante 1993). In 1994, the Atlantic Flyway Council, U.S. Fish and Wildlife Service, and Canadian Wildlife Service provided funding for an operational annual survey of the Ungava Peninsula (regions 1–3) using the same stratified sampling technique but with a new set of transects that would be surveyed each year. Using data for regions 1–3 only, it was estimated that there were 118 000 pairs on the Ungava Peninsula in 1988 (Fig. 7). The 1993 estimate yielded 91 300 pairs, a 23% decline. The population continued to decline in 1994 and again in 1995, when it reached a historic low of only 29 300 pairs (Fig. 3). This precipitous decline prompted the closure of sport hunting seasons in 1995.

1996–2004

The year 1996 was a pivotal year for AP Canada Geese. For the second consecutive year, sport hunting was closed throughout the population's range in order to increase adult survival rates, and the Atlantic Flyway Council developed an Action Plan specific for this population. This new plan established an interim population goal of 150 000 breeding pairs for the Ungava Peninsula and 25 000 pairs for the boreal forest (including region 4) of Quebec. The plan outlined a strategy that included monitoring and research to help the population recover. Furthermore, for the first time since its inception, the breeding pair survey recorded an increase in the number of breeding pairs.

In 1997, the number of breeding pairs increased again. In 1998, however, the population declined. Owing to logistical problems that year, the survey was flown later than usual, and some clutches had already hatched. Because geese with young are more difficult to detect, it was felt that the 1998 estimate was biased low. This evaluation of the 1998 survey results was probably correct, as the population grew strongly over the next 4 years (Fig. 7).

By 2002, the population had reached an estimated 164 800 pairs. From the historic low of only 29 300 pairs in 1995, this represented a fivefold increase in 7 years. Since 2002, the population appears to have stabilized and in 2004 was estimated at 174 800 pairs. The recovery was sufficient that most states and provinces started allowing a restrictive sport harvest in 1999, with the key wintering states of

Figure 6. Study area and location of transects for the breeding pair survey (BPS), 1994–2004, in northern Quebec.

Maryland and Delaware following suit in 2000. By 2003, all AP harvest restrictions in Canada had been removed; in the United States, a 45-day season is permitted in all Atlantic Flyway states excepts parts of Virginia and North Carolina (Hindman *et al.* 2004a).

The Hudson and Ungava bay coastal lowlands have the highest densities of breeding pairs (Malecki and Trost 1990; Harvey and Rodrigue 2004). Up until 2000, pair densities along both bays were similar; since 2001, however, the density along Hudson Bay has more than doubled, whereas it has remained stable along Ungava Bay (Fig. 8). Differential survival or productivity between the two sites may be responsible.

The annual breeding pair survey does not cover the boreal forest of Quebec, for which the 1996 Action Plan had specified a population goal of 25 000 pairs. The southern part of the boreal forest is covered, however, by the Black Duck Joint Venture survey. This is a helicopter breeding pair survey carried out each year for the American Black Duck (*Anas rubripes*) and other waterfowl species (Bordage *et al.* 2003). Since 1990, the Black Duck Joint Venture estimate of the number of AP breeding pairs in the southern boreal forest has fluctuated between 10 051 and 26 196 (Fig. 7) (D. Bordage, pers. comm.).

Productivity indices

To understand changes in population size, data on harvest, survival, and productivity are required. Prior to 1996, information on survival and annual productivity of AP geese was lacking. To obtain this information, the 1996 Action Plan recommended funding for a study of nesting and brood-rearing ecology, a long-term monitoring program to measure annual breeding effort and success at key locations on the Ungava Peninsula and an annual banding program. The latter would provide information on migration routes, survival rates, and annual productivity.

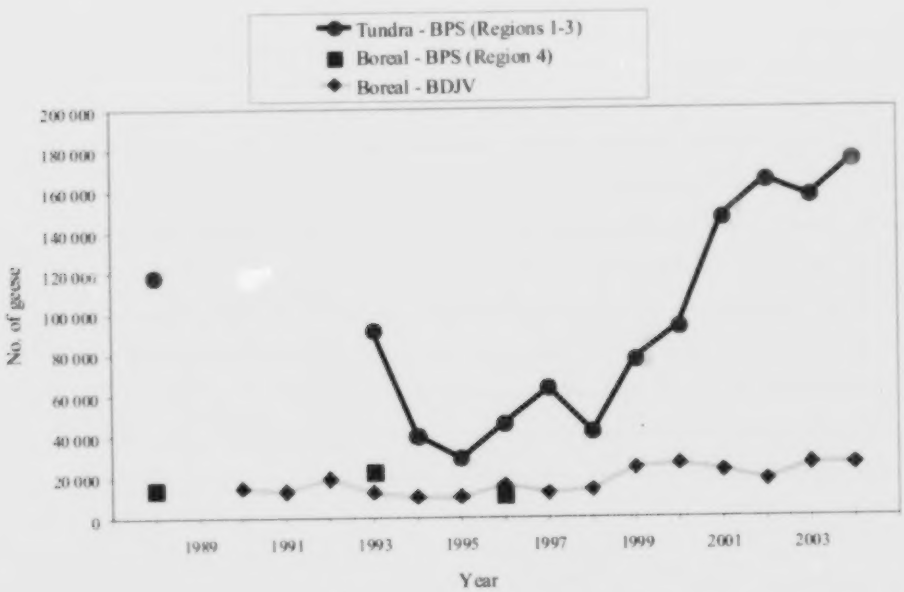


Figure 7. Estimated number of AP Canada Goose breeding pairs on the Ungava Peninsula (breeding pair survey [BPS], regions 1–3) and in the northern boreal (BPS, region 4) and southern boreal forest (Black Duck Joint Venture [BDJV]) regions of Quebec, 1988–2004.

Recruitment study

For this study, a 34.5-km^2 study area was chosen on the Polemond River, 8 km inland from the Hudson Bay coast and approximately 60 km south of the Inuit community of Povungnituk (Fig. 6) (Hughes 1998). This study, carried out from 1997 to 2003, found that the timing of nest initiation was highly variable among years, from as early as 21 May in 1998 to as late as 11 June in 2002. Snow cover and the timing of snowmelt in the latter half of May and early June were important factors affecting the timing of egg laying. A late snowmelt delayed the availability of suitable nesting habitat, which in turn delayed the onset of nesting.

The trend in the number of nests initiated in the study area tracked the trend in the number of breeding pairs on the Ungava Peninsula. Between 1997 and 2001, both the number of breeding pairs and the density of nests doubled, and the correlation between the two was highly significant ($r^2 = 0.87$, $P = 0.02$). Since 2001, the size of the breeding population has stabilized, varying less than 15% from year to year. Nest density has also stabilized; in 2003, the last year of the study, it was only 6% higher than in 2001 (Fig. 9). In 2002, however, the number of nests declined, even though the number of breeding pairs continued to grow. Snowmelt was very late in 2002, resulting in a mean nest initiation date of 11 June, approximately 2 weeks later than the long-term average. For many pairs it was too late, and a large proportion of the breeding population did not attempt to nest.

Annual mean clutch size ranged between 3.6 and 5.3 eggs per nest, and Mayfield nesting success (Mayfield 1961) ranged from 20% to 89% (Fig. 9). For both, the highest values were recorded in 1998, the year with the earliest nesting date, whereas the lowest values were recorded in the 2 years (2000 and 2002) with the latest nesting dates. Our findings indicate that a late snowmelt not only may cause many pairs to forego nesting altogether, but also causes those that do initiate nesting to lay smaller clutches and generally to be less successful in having at least one gosling hatch.

Gosling survival (i.e., from hatch to banding) was fairly consistent from year to year, varying between 42% and 63%

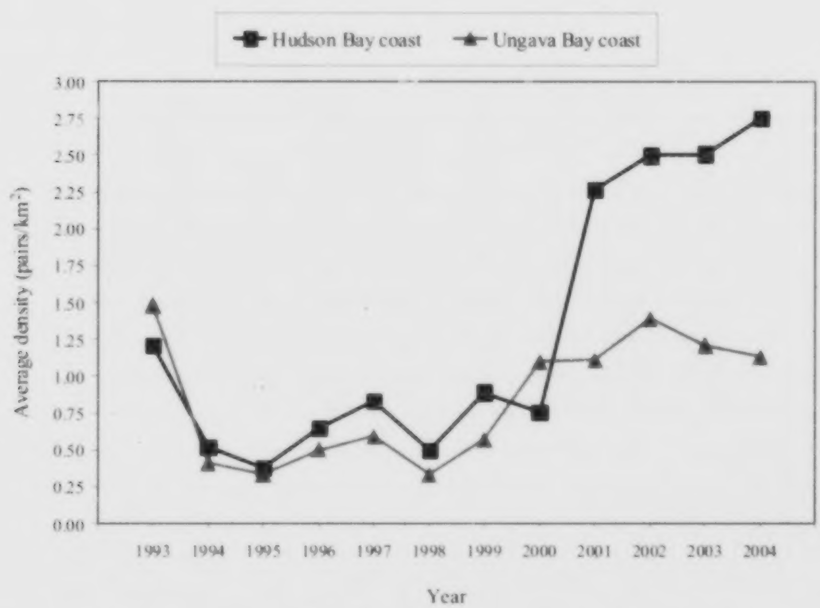
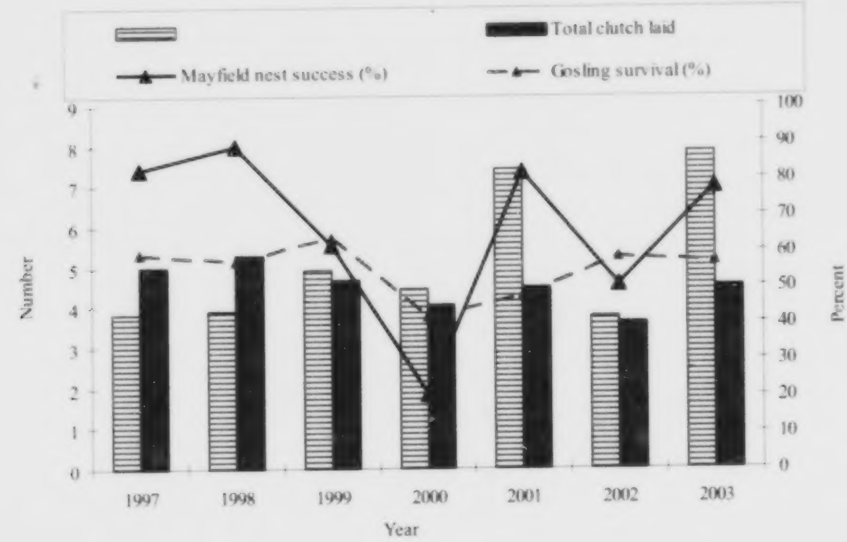
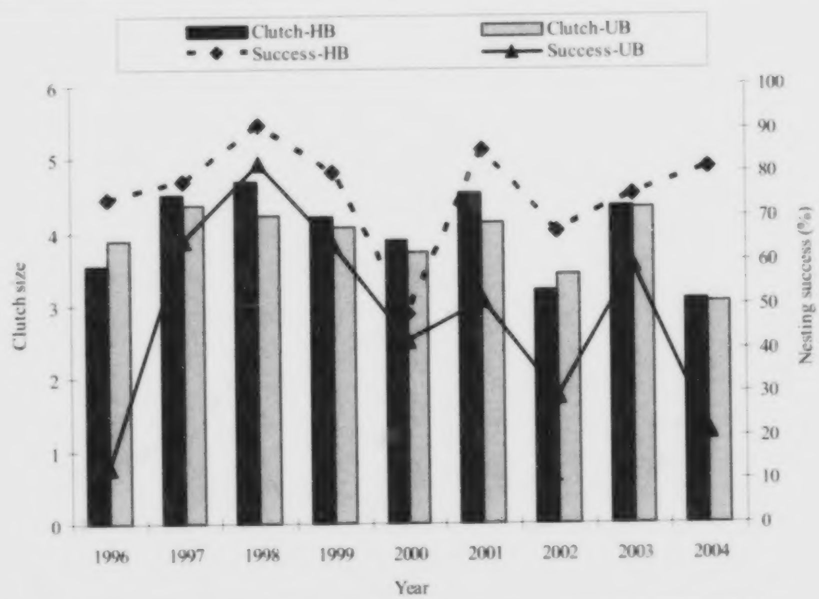


Figure 8. Average density of breeding AP Canada Goose pairs for the Hudson and Ungava bay coastal zones, 1993–2004 (adapted from Harvey and Rodrigue 2004).



Nest initiation: 29/05	21/05	23/05	1/06	24/05	11/06	28/05

Figure 9. Reproductive parameters of AP Canada Geese at the Polemond River, 1997–2003. Note that the mean nest initiation date (dd/mm) is given at the bottom of the graph.



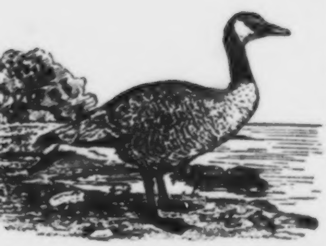
Nest initiation:								
Hudson B.: 08/06	28/05	21/05	24/05	01/06	23/05	09/06	01/06	05/06
Ungava B.: 04/06	25/05	24/05	25/05	02/06	20/05	11/06	18/05	08/06

Figure 10. Reproductive parameters of AP Canada Geese nesting in the Hudson Bay (HB) and Ungava Bay (UB) secondary sites, 1996–2004. Note that the mean nest initiation date (dd/mm) is given at the bottom of the graph.

Table 1. Number of AP Canada Geese banded and the immature to adult ratio from Hudson Bay and Ungava Bay in northern Quebec, 1997–2004.

	Hudson Bay		Ungava Bay	
Year	No. banded	Immature to adult ratio	No. banded	Immature to adult ratio
1997	1 148	2	1 998	1.09
1998	3 821	1.78	2 007	1.82
1999	5 332	1.45	2 239	1.15
2000	2 619	0.99	1 928	1.16
2001	5 948	1.88	2 511	1.8
2002	4 560	1.21	2 644	1.4
2003	5 828	1.71	4 164	1.86
2004	2 888	1.23	1 694	1.06
Total	32 144	1.53	19 185	1.42

(Fig. 9). Goslings usually hatched in either the last week of June or the first week of July, and the banding operations commenced 4–6 weeks later.



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Long-term monitoring

The ongoing program to monitor annual breeding success across the Ungava Peninsula began in 1996. Each year, several small study sites in key nesting areas, along the northeastern Hudson Bay coast and the southern Ungava Bay coast, are visited by helicopter. Sites are visited in June to locate nests and record clutch size and again in late July or early August to assess nest success.

Clutch size at Ungava Bay sites was positively correlated with that at Hudson Bay sites ($r^2 = 0.84$, $P < 0.01$) (Fig. 10). However, apparent nesting success at Ungava Bay was not significantly correlated with nesting success at Hudson Bay ($r^2 = 0.50$, $P = 0.08$). Each year, nesting success is lower at Ungava Bay than at Hudson Bay. Although quantitative data are lacking, this difference may be a result of higher predation rates at the Ungava Bay sites, in particular by black bears (*Ursus americanus*), which are rare along Hudson Bay.

Banding program

Since 1997, banding crews working out of Kuujjuaq (Ungava Bay) and Povungnituk (Hudson Bay) have annually captured and banded an average of 6400 AP Canada Geese, resulting in over 51 000 geese banded to date. The ratio of immature geese (i.e., goslings) to adult geese at the time of capture provides a good index of productivity for that year. A year with poor production (small clutches, low nesting success, etc.) results in comparatively fewer goslings being caught during the banding drives, and hence a lower immature to adult ratio, than in a year with good production. Between 1997 and 2004 at Hudson Bay and Ungava Bay, the ratio has varied between 0.99:1 and 2.00:1 (Table 1).

From 1988 to 2002, annual survival rates, as calculated from band recovery data, were higher among adults than among juveniles. Annual survival of adults was estimated at 88% and was constant across years, whereas annual survival of juveniles ranged between 57% and 71%. Among adults, there was no difference in survival between males and females (Reed and Hughes 2004).

Conclusion

The AP Canada Geese, after reaching a historic low in 1995 of only 29 300 pairs on their major breeding grounds on the Ungava Peninsula, have largely recovered. Each year since 2001, the size of the breeding population has surpassed the 118 000 pairs recorded in 1988, the year of the first breeding ground survey. The most recent breeding ground surveys, conducted in 2004, produced an estimate of 174 800 pairs on the Ungava Peninsula

(Harvey and Rodrigue 2004) and 25 650 in the southern boreal forest (D. Bordage, pers. comm.). A plan is currently being developed by the Canadian Wildlife Service and the U.S. Fish and Wildlife Service for an annual fixed-wing aerial breeding ground survey covering the central and northern parts of the boreal forest in Quebec, the one area for which population estimates for AP geese are lacking.

The recovery of the AP Canada Geese was possible because of decisive actions by state, provincial, and federal wildlife agencies in the mid-1990s, in particular the complete closure of sport hunting in Canada and the United States for a number of years, as well as the implementation of research and banding programs. As discussed in detail by Hindman *et al.* (2004b), many lessons were learned with respect to the management of a wildlife population, especially the importance of population-specific surveys to track population trends and the value of an Action Plan detailing goals, objectives, and strategies for the recovery and/or maintenance of a population at a healthy level.

For AP Canada Geese on the Ungava Peninsula, reproduction is good in most years, and the geese clearly have a very high reproductive potential. The most important factor affecting productivity is weather, specifically temperature and snow cover during the critical egg-laying and early incubation periods (late May to early June). These two variables have a direct effect on the timing of snowmelt, which in turn affects the timing of nest initiation. A late snowmelt delays the availability of suitable nesting habitat, which in turns delays the onset of nesting and even discourages many pairs from attempting to nest. Furthermore, those pairs that do nest lay smaller clutches and generally are less successful in having at least one gosling hatch.

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Monitoring seabird mortality: the Cape Breton Beached Bird Survey

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Tens of millions of seabirds winter in the cold waters of the North Atlantic Ocean. These same waters also serve as commercial fishing grounds and major shipping lanes linking Europe with North America (Elliot *et al.* 2002). Oil pollution resulting from this heavy sea traffic, whether from chronic operational discharges or accidental spills, has been estimated to kill as many as 300 000 seabirds each year off the coast of southeastern Newfoundland (Wiese 2002). One of the most useful ways for monitoring the effects of oil pollution on seabirds is by conducting beached bird surveys. Regularly repeated beached bird surveys have been widely used around the world to monitor the mortality of seabirds.

In 2001, Bird Studies Canada, in cooperation with the Canadian Wildlife Service, initiated the volunteer-based Cape Breton Beached Bird Survey. The goals of the survey are to establish a baseline index of "normal" levels of occurrences of beached birds and to monitor the effects of oil pollution and other events that cause an increase in seabird mortality.

Surveys are conducted by volunteers from November to April, although a few are conducted during the summer months. Volunteers survey their beaches once at the end of each month, looking for dead birds. When birds are found, volunteers record the species and cause of mortality (when known). When oil is present on a carcass, volunteers record the degree of oiling in terms of the amount of the carcass covered in oil. The ratio of oiled birds to beached birds (oiling rate) provides a good indication of the severity of oil pollution in the region in any given year. The deposition rate, or the number of beached birds per kilometer, controls for differences in survey effort.

Table 2 shows the number of beached birds found, the oiling rate, and the deposition rate on Cape Breton beaches since the survey started in 2001. A major oil tanker spill off the coast of Cape Breton in February 2002 contributed to the high oiling rate in that year. Heavy deposition of sea ice likely contributed to the low number of beached birds found

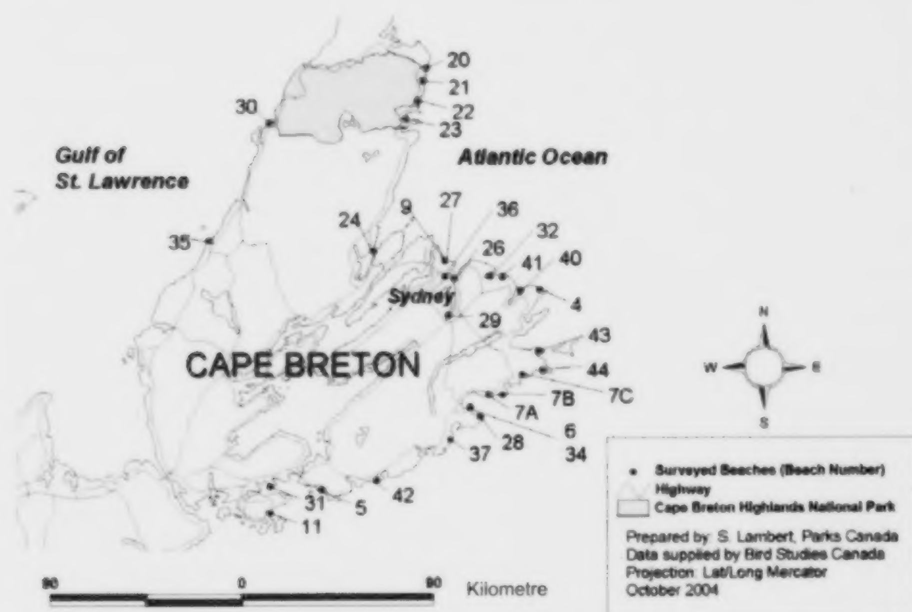

Figure 11. Cape Breton Beached Bird Survey locations in 2003–2004.

Table 2. Summary data for the first 3 years of the Cape Breton Beached Bird Survey.

Year	No. of surveys	No. of beached birds	No. of oiled birds	Oiling rate (%)	Deposition rate (birds/km)
2001–2002 (November 2001 – April 2002)	80	42	36	85.7	0.44
2002–2003 (May 2002 – June 2003)	88	8	0	0	0.07
2003–2004 (July 2003 – July 2004)	118	30	6	20	0.1
Total	286	80	42	52.5	0.16

in 2002–2003. Figure 11 shows the location of beached bird surveys in Cape Breton in 2003–2004.

After three seasons of conducting beached bird surveys, a grand total of 80 beached birds have been found during 286 surveys. The most common species of birds found are Dovekie (*Alle alle*), Herring Gull (*Larus argentatus*) and Great Black-backed Gull (*L. marinus*), Thick-billed Murre (*Uria lomvia*) and Common Murre (*U. aalge*), and Northern Gannet (*Morus bassanus*). Of the 80 birds found in the last 3 years, 42 were oiled to varying degrees, for an overall oiling rate of 52.5%. Oiling was also found to be the major cause of death of beached birds off the coast of Newfoundland. From 1984 to 1997, 70.98% of carcasses discovered during beached bird surveys were oiled (Wiese and Ryan 1999). Beaches on the Pacific coast have much lower oiling rates, perhaps due to differences in the populations of seabirds found off each coast and the ocean processes (wind, currents) that bring seabird carcasses ashore (Burger 2002).

The Cape Breton Beached Bird Survey is continuing for its fourth season in 2004–2005, after which a thorough assessment of the survey's value will be undertaken. Bird Studies Canada also hopes to expand beached bird surveys to the Bay of Fundy in 2005, should funding applications, currently under review, be approved. Finally, Bird Studies Canada, partnering with the Seabird Ecological Assessment Network of Tufts University and the Coastal Observation and Seabird Survey Team (COASST) of the University of Washington has produced *Beached Birds: A COASST Field Guide to the North Atlantic*. This book provides a detailed key, including photos and drawings, for identifying dead birds and will be useful in the identification of beached birds as well as birds caught as by-catch in the fishing industry.

For more information on beached bird surveys in Atlantic Canada, including the most recent report, visit www.bsc-eoc.org/regional/acbeachbird.html or contact Becky Whittam, Atlantic Canada Program Manager of Bird Studies Canada, at bwhittam@bsc-eoc.org, telephone 506-364-5047.

Acknowledgements

Thanks are extended to all the volunteers who have walked their beaches throughout the year, but especially during the cold and snowy winter months. Funding for this survey is provided by the Atlantic Region of Environment Canada.

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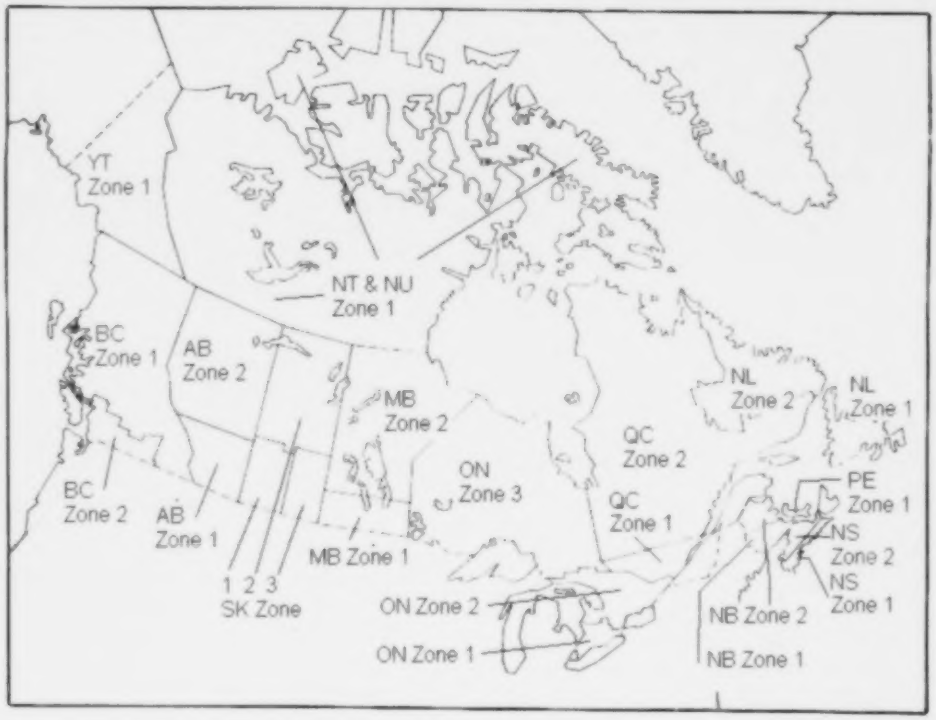

Figure 12. Geographic areas of National Harvest Survey zones.

Recent trends in the duck harvest in Canada

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Background

In 1967, the Canadian Wildlife Service initiated the National Harvest Survey to gather some of the data needed to manage migratory game bird species. The survey consists of two surveys sent annually to a sample of purchasers of the Migratory Game Bird Hunting Permit. These two surveys are the Harvest Questionnaire Survey (HQS) and the Species Composition Survey (SCS), also known as the Wing and Tail Survey. Data from these surveys, together with data from breeding and wintering population surveys, are used to assess the status of migratory game bird populations in Canada and the United States.

The HQS is sent in the fall to approximately 45 000 hunters randomly selected across 23 geographic hunting zones (Fig. 12). The sample is stratified into four groups, based on where the hunter is resident and whether or not he or she held a permit in the previous year. Hunters are asked to report on when and how often they hunted and the numbers of migratory game birds killed. The main goal of this survey is to estimate the total harvest of migratory game birds and hunting activity across Canada.

A smaller group of hunters is asked to participate in the SCS. They send a wing from each duck they shoot, or the tail and primary feathers of each goose, with details about date and location of the kill. Participants in the SCS are selected using a different process from that used for the HQS. Participants are selected from a list of permits sold the previous year, because the survey materials (i.e., wing and tail envelopes) need to be mailed before the start of the current hunting season. To minimize the cost associated with mailing packages of expensive wing envelopes, we first confirm hunters' willingness to participate in the SCS by sending out a participation card in late June. Potential

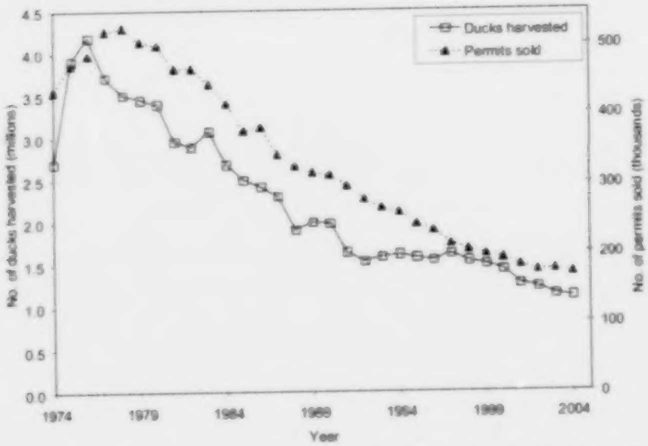

Figure 13. Estimates of total duck harvest and sales of Migratory Game Bird Permits in Canada from 1974 to 2004.

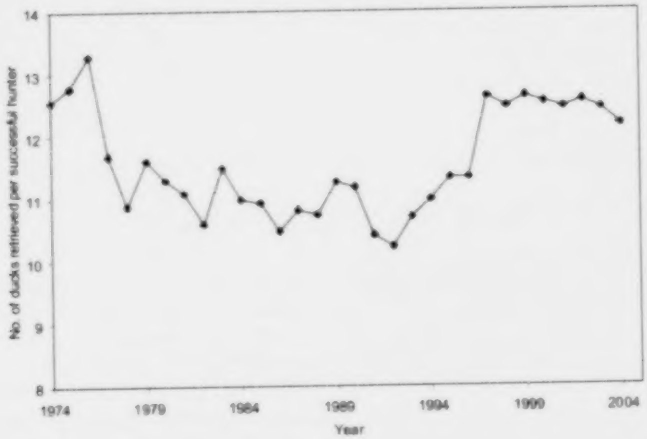

Figure 14. Annual average of retrieved ducks per successful duck hunter from 1974 to 2004.

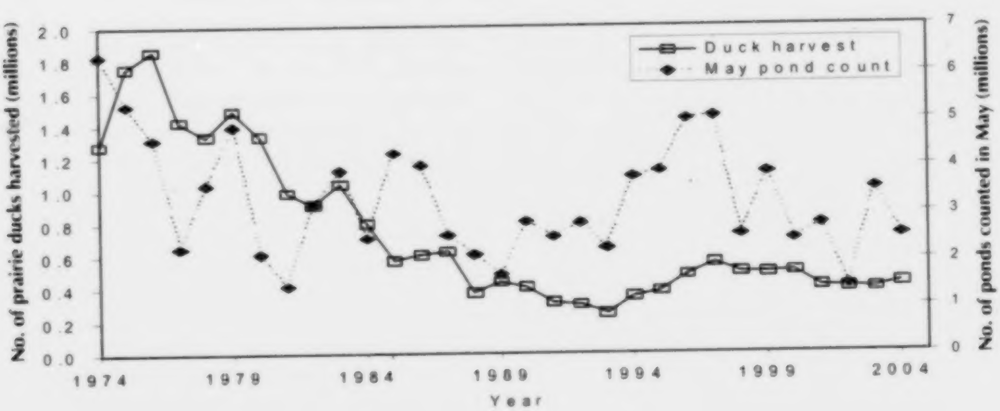

Figure 15. Estimates of duck harvest and number of ponds counted in May in the Prairie provinces from 1974 to 2004.

participants are selected randomly and are grouped based on their previous participation in the survey, hunting success, residency, and permit renewal status. Hunter selection is biased towards hunters who have previously cooperated. This is beneficial because it increases the response rate, the precision of our estimates, and the cost efficiency of the survey. The SCS, in combination with the HQS, is used to generate harvest estimates for each game bird species as well as to determine the age and sex composition of the harvest.

More details on survey design and methodology for these two surveys can be found in Cooch *et al.* (1978).

Duck harvest trends

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Duck harvest in Canada has been steadily declining over the last 30 years, from 4.2 million in 1976 down to 1.1 million in 2004 (Fig. 13). There are several factors that could influence harvest levels from year to year for a given geographic area. For example, changes in waterfowl population size, the proportion of young in the population (as young are known to be more vulnerable to hunting), weather conditions during the harvest, and hunting regulations (e.g., bag limit and season length) are all known to influence harvest levels to some degree.

It appears that most of the long-term decline in total harvest of ducks across Canada can be explained by a decline in the number of hunters, as measured by declines in federal Migratory Game Bird Permit sales (68% decrease; Fig. 13). As documented by Boyd *et al.* (2002), permit sales had declined from 1978 to 1998. Since then, permit sales across Canada have continued to decline by 17% (Fig. 13), with the greatest decline observed in British Columbia (35%) and the least in Quebec (4%). The net increase of permit sales observed in Newfoundland and Labrador (13%) reflects a change in hunting regulations in 2001–2002, which now require all murre hunters to purchase a hunting permit. The reader can refer to Boyd *et al.* (2002) for a discussion on projected permit sales in the coming years based on past and current age distributions of hunters.

Despite the long-term decline in the Canadian duck harvest, the annual average number of ducks retrieved per successful hunter has remained relatively stable over the same period, with an overall average of 11.5 (Fig. 14). An increase of 1.3 ducks per hunter was recorded in 1997, after which annual estimates have since remained steady (i.e., at approximately 12.5 birds per hunter).

Duck harvests also appear to be influenced by habitat conditions. In the Canadian prairies, the number of ponds in May (as counted during aerial surveys) varies nearly five fold from very dry years to very wet years (Fig. 15). Many more ducks breed in the prairies during wet years, with the result that more young are produced. In dry years, ducks may breed farther north in the boreal forest, or they may fail to breed. This variation in productivity is reflected in the harvest, with a tendency for an increased harvest following a wet spring (or series of wet springs) and decreased harvest after dry springs (Fig. 15). The relationship is not simple, though, and clearly other factors are also influencing the harvest in any given year.

In the Prairies, the duck harvest also consists predominantly of Mallards (>63%). Other species important in the harvest include Northern Pintail, Gadwall (*Anas strepera*), and Blue-winged Teal (*A. discors*). Similar to the situation in British Columbia, there has been little variation in the relative importance of species in the harvest over the last 30 years (Fig. 16b).

Species composition and patterns are considerably different in eastern Canada, with duck harvest distributed among many more species, including some diving ducks and sea ducks. In Ontario, the Mallard harvest has only recently exceeded 40% of the total duck harvest for the province (Fig. 16c). Other notable species in the harvest include Wood Duck (*Aix sponsa*), Green-winged Teal (*Anas crecca*), Ring-necked Duck (*Aythya collaris*), and American Black Duck (*Anas rubripes*). Historically, the relative importance of Mallard, Wood Duck, and Green-winged Teal has increased, whereas American Black Ducks, Lesser

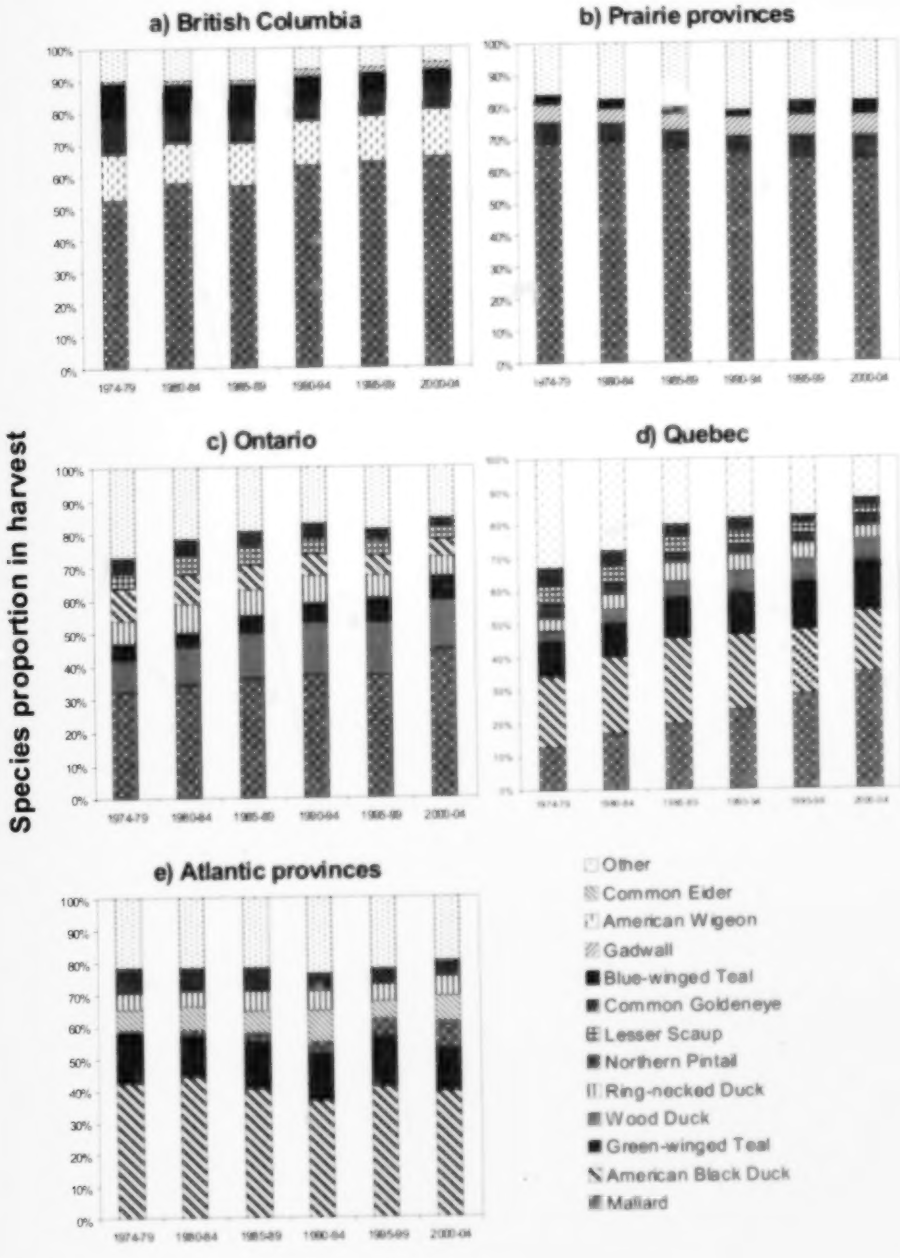

Figure 16. Historical species composition of duck harvest by region.

Scaup (*Aythya affinis*), and Common Goldeneye (*Bucephala clangula*) have been contributing less to the harvest. In Quebec, the relative importance of Mallards has doubled since the mid-1970s (Fig. 16d). Proportional increases have also occurred for Green-winged Teal and Wood Duck (similar to Ontario). Conversely, the importance of American Black Ducks has decreased, as has that of Blue-winged Teal, scoters, and mergansers (as part of the "other" category).

In the Atlantic region, the harvest has been consistently dominated by the American Black Duck take (~40%). Other important species include Green-winged Teal, Mallard, Common Eider (*Somateria mollissima*), and Ring-necked Duck.

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Evidence of recent population increases in Common Eiders breeding in Labrador

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Populations of several sea ducks are declining across their North American ranges (Sea Duck Joint Venture Management Board 2001), including populations of all four eider species (*Somateria spp.* and *Polysticta stelleri*) (Kertell 1991; Stehn *et al.* 1993; Gratto-Trevor *et al.* 1998). Declines in Common Eider (*Somateria mollissima*) populations have been documented in Greenland, Hudson Bay, and Alaska (Robertson and Gilchrist 1998; Suydam *et al.* 2000; Merkel 2004). Reasons behind these population decreases vary, and many are unclear. Factors identified as causing these declines include human disturbance, overharvesting, and climatic events (Robertson and Gilchrist 1998; Suydam *et al.* 2000; Merkel 2004). However, not all Common Eider populations in the north are decreasing; Christensen and Falk (2001) found evidence of an eider population increase in northwest Greenland, whereas others have documented increases in Hudson Strait (Hipfner *et al.* 2002; Falardeau *et al.* 2003).

Labrador has breeding populations of the Northern Common Eider (*S. m. borealis*), the American Common Eider (*S. m. dresseri*), and intergrades of the two subspecies (Mendall 1986). Mendall (1980) documented this zone of overlap, but the geographic extent and consequences for population structure and recruitment have not been fully explored. Most information related to eider breeding ecology in Labrador is outdated (e.g., population trends) or unknown (e.g., migration routes and wintering locations). In terms of population affinities, eiders breeding in Labrador are thought to overwinter in Atlantic Canada and the northeastern United States (Palmer 1976; Goudie *et al.* 2000).

In 1998, the Canadian Wildlife Service, in conjunction with the Labrador Inuit Association, initiated surveys on the Labrador coast to collect information to estimate breeding eider population trends. These surveys were initiated in anticipation of the finalization of the Labrador Inuit Association land claims, subsequent establishment of the Nunatsiavut land claim area, and creation of natural resource co-management boards. Surveys covered approximately 750 km of the Labrador coast and were repeated annually from 1998 to 2003; owing to logistical reasons, not all islands were surveyed every year. This paper reports the findings of these monitoring efforts and compares them with results from other studies.

Study area

We surveyed archipelagos near Nain and Hopedale from 1998 to 2003; St. Peter's Bay was surveyed in 1999, 2001, and 2002 (Chaffey 2003); and Rigolet was

surveyed from 2000 to 2003. The Nain study area was approximately 2237 km^2 and contained 811 islands ranging in size from 0.01 to 44 800 ha. The Hopedale study area was approximately 959 km^2 and contained 838 islands ranging in size from 0.01 to 3875 ha. The Rigolet study area was approximately 3172 km^2 and contained 348 islands ranging in size from 0.02 to 5204 ha. The St. Peter's Bay study area was approximately 14 km^2 and contained 20 islands ranging in size from 0.03 to 23.43 ha.

All regions shared similar environmental characteristics, such as a northern maritime climate and vegetation composed primarily of mosses, lichens, forbs, grasses, and sedges. The archipelagos of Nain, Hopedale, and Rigolet typically comprised barren islands with sparse vegetation and very limited nesting cover. Islands in St. Peter's Bay had more ground vegetation and woody cover, such as stunted black spruce (*Picea mariana*). All four archipelagos are classified as coastal barrens (Lopoukhine *et al.* 1978) and are considered to have a high-boreal ecoclimate (Meades 1990) and a low-Arctic oceanographic regime (Nettleship and Evans 1985).

Survey methods

In all areas, islands were selected for study based on random or haphazard sampling (Chaulk *et al.* 2005). We limited our searches to islands that were estimated to be smaller than 30 ha. We did this for logistical reasons, as large islands require significant effort to search; instead, we focused on smaller islands that could be easily censused by small field crews over restricted time periods. We conducted ground surveys using standard search methods employed by the Canadian Wildlife Service (Nettleship 1976) and other researchers (Falardeau *et al.* 2003; Merkel 2004); these consisted of 2–4 people systematically walking over the islands searching for signs of eider nesting. Islands in the four northern archipelagos had limited cover; hens and unattended nests were easily detected. In several instances, we stopped island searches because of weather or logistical considerations. If searches were halted, the island was classed as partially searched and was not used in trend analysis. Islands were searched only once per year. Surveys were initiated in the south, and the survey crews moved north as the summer progressed. Surveys were timed to occur during mid-incubation, but actual timing varied slightly by archipelago and by year (Table 3).

Data analysis

Sample sizes for the annual monitoring effort were estimated based on data collected in Nain and Hopedale during 1998 using the software program MONITOR and its exponential model (Gibb 1995). We input island nest counts and an archipelago-level standard deviation and varied the number of islands, surveys, and survey occasions to produce a matrix of possible sampling schemes that would generate statistical power greater than 0.80 with alpha=0.10. Archipelago-level standard deviation was calculated using the bootstrap method (Sokal and Rohlf 1995).

Table 3. Survey dates by year and archipelago for nesting common eiders on the coast of Labrador from 1998–2003.

Year	Nain	Hopedale	Rigolet	St. Peter's Bay
1998	6-10 July	30 June -4 July		
1999	13-15 July	4-12 July		22-23 June
2000	3-9 July	28-30 June	20-26 June	
2001	5-19 July	4-17 July	18-27 June	11 June
2002	13-22 July	3-17 July	17-22 June	5-9 June
2003	11-13 July	3-7 July	14-20 June	

The sampling scheme matrix was used to guide sampling effort in post-1999 sampling years.

For trend estimation, we used nest counts from islands that were completely searched and ran the analysis using islands searched a minimum of 2, 3, and 4 years. Trends were estimated using the program ESTEQNINDEX, which fit the mean island nest count to a two-way model with terms for year and island. Maximum likelihood estimates of year effects were calculated assuming that observed counts had a Poisson distribution. An exponential trend was then fit through the year effects, and the jackknife estimate of the standard error was computed. This procedure was originally developed for analysis of the Breeding Bird Surveys and allows trend analysis with missing data (Collins 2003).

Results

From 1998 to 2003, 117 islands (Table 4) were completely surveyed a total of 479 times in four archipelagos (Nain, Hopedale, Rigolet, St. Peter's Bay); over this period, we counted 13 185 eider nests. Average nest counts per island in Hopedale increased from a low of 3.3 in 1998 to over 10.7 in 2003, whereas in Nain, average nest counts per island increased from a low of 14.5 in 1998 to over 46.3 in 2003 (Table 5). Our most comprehensive study year was 2002, in which we sampled 109 islands in four archipelagos and counted 3239 nests. These 109 islands represent about 5.8% of all islands smaller than 30 ha.

Results based on islands surveyed a minimum of 4 years showed an average apparent annual increase of 21.6% for Nain, 13.4% for Hopedale, and 18.1% for all areas over the 6-year period from 1998 to 2003 (Table 6). These estimates varied slightly with the number of survey years; for example, the value for all islands surveyed a minimum of 2 years was 17.5% compared with 18.1% for islands surveyed a minimum of 4 years (Table 6).

Discussion

As a result of logistics, not all islands were surveyed each year, and assessments based on archipelago-level or year summaries tend to be misleading when plot or route data are missing. However, the program ESTEQNINDEX allows for trend estimation with missing data (Collins 2003). Based on our analysis of average nest initiation dates, which ranged from a mean of 5 June in St. Peter's Bay to 23 June in Nain (Chaulk *et al.* 2004, 2005), we feel confident that our surveys were well timed to occur in mid- to late incubation. On average, about 71% of nests were classed as incubating, and only 10% were classed as hatched or hatching (Chaulk *et al.* 2005). Meanwhile, analysis of our sampling design suggests that within the subset of islands smaller than 30 ha, the sampling effort was not spatially biased (KGC, unpubl. data). We feel confident that nest detection rates were high due to the absence of obscuring ground cover.

Recent studies of Northern Common Eider population trends have shown drastic and disturbing patterns of population decline (Robertson and Gilchrist 1998; Suydam *et al.* 2000; Merkel 2004). Fortunately, our results show positive population growth for eider populations in Labrador. The average levels of population increase that we have detected are very high (13–22%). Given the geographic coverage of our surveys and the intensity of island searches that ranged from two to four archipelagos and from 45 to 109 islands per year, we feel that our results are representative of Common Eider population trends in Labrador. From 1998 to 2003, average population growth in Nain was almost twice that in Hopedale. Reasons for these regional differences are unknown, but could be related to local environmental conditions and/or harvesting practices. However, we lack data for both these factors and can make no substantiated assessment at this time.

In 1980, Lock (1986) conducted aerial surveys for breeding eiders and estimated 15 000 pairs on the Labrador coast. During the mid-1990s, S. Gilliland

Table 4. Sampling effort from 1998–2003 and summary of islands and their sizes for each archipelago surveyed on the Labrador coast from 1998–2003.

Archipelago	Number of islands < 30 ha searched between 1998-2003	Number of islands in archipelago	Number of islands < 30 ha in archipelago
Nain	36	811	740
Hopedale	49	838	789
Rigolet	22	348	326
St. Peter's Bay	10	20	20
Total	117	1995	1875

Table 5. Average ± SD number of nests per island by archipelago and year[1]. Data collected on the Labrador coast from 1998–2003.

Archipelago	1998	1999	2000	2001	2002	2003
Nain	14.5 ± 19.6	17.6 ± 23.9	21.6 ± 26.3	32.4 ± 24.1	40.7 ± 52.4	46.3 ± 51.9
Hopedale	3.3 ± 7.1	4.3 ± 7.8	5.7 ± 9.8	4.8 ± 7.7	5.4 ± 8.4	10.7 ± 20.4
Rigolet			90.5 ±153.9	144.9 ± 195.9	74.9 ± 86.9	141.3 ± 167.1
St. Peter's Bay		55.9 ±57.0		81.0 ± 93.0	42.9 ± 51.1	

[1] Note that these average values do not take into account missing data (some islands were not searched every year) and are presented as general information.

Table 6. Apparent annual change (%) in breeding common eider populations on the Labrador coast from 1998–2003. Due to limited samples sizes values for Rigolet and St. Peter's Bay were not presented individually (see footnote). These values are based on an analysis conducted using the program ESTEQNINDEX, which calculates population trend with missing data (Collins 2003).

Archipelago	Minimum Number of Survey Years	Number of Islands used in the Model	Apparent Annual Percentage Change in Breeding Population	95 % CI	
				Lower	Upper
Nain	4	21	21.6	1.6	35.8
	3	26	21.6	6.1	39.5
	2	36	22.4	7.5	39.2
Hopedale	4	34	13.4	2.4	25.6
	3	40	13.1	2.2	25.3
	2	49	14.8	3.8	26.8
All	4[a]	58	18.1	6.7	30.7
	3[b]	79	17.5	6.7	29.4
	2[b]	117	17.5	8.2	27.5

[a] includes Islands from Nain, Hopedale & Rigolet

[b] includes islands from Nain, Hopedale, Rigolet & St. Peter's Bay

(unpubl. data) conducted aerial surveys in Labrador and estimated 30 000 breeding pairs of eiders and an annual growth rate of 3.7% per year during the intervening period. However, these two surveys were not directly comparable, given the highly different methodologies employed (S. Gilliland, unpubl. data), so both the status and trend of eider populations remained unclear through the 1980s and 1990s. We are reluctant to use our data to generate population estimates, as our study was designed for trend estimation. Our most comprehensive study year was 2002, in which we sampled 5.8% of all islands smaller than 30 ha. Owing to the limited quality of base maps, we have no way to determine what proportion of islands smaller than 30 ha are actually suitable for nesting eiders. Some islands might be submerged at high tide, be connected to the mainland at low tide, offer little shelter from ocean storms, or have cabins situated on them. Previously, we found that eider island occupancy ranged from 30% to 80% of islands surveyed, but these occupancy rates varied with archipelago (Chaulk *et al.* 2005). In the meantime, estimates of eider population size in Labrador will be unreliable until we can quantify the number of islands that are available to and suitable for breeding eiders.

Specific factors influencing eider population growth in Labrador could include improvement of environmental conditions or changes in migration patterns and subsequent changes in harvest on the breeding and wintering grounds. Other factors that may have influenced population growth include nest shelter programs that were initiated in the 1990s, eider conservation education programs implemented during the 1990s, and reductions in eider bag limits during the 1980s and 1990s. In addition, the commercial Atlantic salmon (*Salmo salar*) and cod (*Gadus spp.*) fisheries were closed in the early 1990s. Researchers have identified human disturbance as a key factor influencing eider distributions and reproductive performance (Blumton *et al.* 1988; Johnson and Krohn 2002). Closure of these fisheries could have improved conditions for breeding eiders by reducing human disturbance near colonies, reducing hunting on the breeding grounds, and eliminating by-catch in nets as a mortality source. In addition, large gull populations in Labrador appear to be declining (Robertson *et al.* 2002) and may have further improved breeding conditions for eiders through a reduction in avian predation rates.

Based on the information presented above, we think there are numerous reasons why breeding eider populations in Labrador are increasing. However, we are not certain why an adjacent population in southwestern Greenland is declining (Merkel 2004). It has been suggested that hunting is the main factor causing the decline in Greenland, where eiders are subjected to unsustainable harvest (Merkel 2004). Meanwhile, no recoveries of eiders banded in Labrador have been reported in Greenland (Lyngs 2003), suggesting little or no connection between the two populations. Researchers have suggested that Labrador eiders winter in Newfoundland, Quebec, and the Maritimes (Palmer 1976; Reed and Erskine 1986; Wendt and Silieff 1986; Goudie *et al.* 2000) and may experience lower harvest levels than eiders that winter in Greenland.

Typically, eiders have deferred sexual maturity and exhibit low rates of annual recruitment and reproduction (Coulson 1984), and population growth is tied to adult survival (Goudie *et al.* 2000). However, eider populations can apparently sustain dramatic rates of increase, especially during population regrowth. Chapdelaine (1995) documented 11.3% and 23.5% annual growth for Common Eiders breeding in the Gulf of St. Lawrence. While a number of eider populations in the Netherlands grew at rates between 17% and 28%, this occurred during the early stages of colony growth, which was credited to low mortality and high rates of recruitment (Swennen 2002). Meanwhile, 25–35% per year increases were observed at newly established Danish colonies, mainly due to immigration (Bregnalle *et al.* 2002).

The extent to which anthropogenic factors influenced overall eider population dynamics in Labrador in the 20th century is unknown, yet our evidence suggests significant population increases during the late 1990s and early 21st century. These

growth patterns are similar to those recently observed in insular Newfoundland (S. Gilliland, pers. comm.) and the Gulf of St. Lawrence (Chapdelaine 1995) and is a promising trend for a species undergoing declines throughout much of its range.

Management implications

Common Eiders are an important species for many northern people, as a source of meat, eggs, and down. Despite these demands, management of eider populations in Labrador has been compromised by inadequate population data. This report contains information that will aid managers with respect to setting sustainable harvest levels and will be used by various international, regional, and local management agencies in the development of eider conservation plans. If general conditions remain constant, we feel that current eider harvest levels in Labrador are sustainable, at least in the short term. Given the baseline information that is now in place, we recommend continued population monitoring on a 3 to 4-year rotation. We also suggest expanding the study scope to include unsurveyed portions of the Labrador coast. A rigorous assessment of suitable breeding islands is also suggested; once it is complete, we recommend that regional population estimates be generated.

Acknowledgements

Special thanks go to P. Ryan (Canadian Wildlife Service); E. Anderson, N. Anderson, C. Bradley, K. Dicker, C. Dyson, C. Poole, D. Pottle, and W. Wolfrey (Fisheries and Oceans Canada); and B. Anderson, W. Hunter, E. Merkuratsuk, J. Rowell, I. Winters, and D. Wolfrey (Labrador Inuit Association). Special thanks also go to S. Broomfield for help in preparing the data for analysis and to H. Chaffey for providing the 2002 nest count data for St. Peter's Bay. The Labrador Inuit Association, the Canadian Wildlife Service, the Northern Ecosystem Initiative, the Northern Scientific Training Program, Memorial University of Newfoundland, and Inco Limited provided funding for this study. We also had help from many individuals counting nests and eggs in each community, but there are too many to mention; nonetheless, their help was greatly appreciated and added great value to this project.

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Yellow Rail distribution and abundance in southern James Bay, Quebec

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Introduction

The Yellow Rail (*Coturnicops noveboracensis*) breeds in North America, mainly in the northern United States and in Canada. While its nesting area covers a vast territory, sightings of this species are rare and limited to only a few regions of this territory. The elusive behaviour of this small rail may account for this: it calls more often and regularly during the night than during the day and often nests in large and remote marshes (Bookhout 1995; Robert 1997; Alvo and Robert 1999).

Canada encompasses a considerable portion (about 90%) of the Yellow Rail breeding range. The few published records suggest that the James Bay and Hudson Bay coastal marshes may harbour a high proportion of the world population during the nesting period (Alvo and Robert 1999). Some works suggest that the Yellow Rail is common along the west coast of Hudson Bay and James Bay in Ontario (e.g., Todd 1963; Schueler *et al.* 1974; Peck and James 1983; Cadman *et al.* 1987; Coady *et al.* 2003) and on the Quebec coast of James Bay (Todd 1963; Robert *et al.* 1995). However, no specific Yellow Rail survey has been carried out in these regions, and the available information is anecdotal.

The Yellow Rail is designated as a species of Special Concern in Canada: it is listed in Schedule 1 of the *Species at Risk Act.* It was listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 1999, following the publication of a status report (Alvo and Robert 1999). In Quebec, the species is part of the List of threatened or vulnerable vertebrate wildlife species which are likely to be so designated under the Act respecting threatened or vulnerable

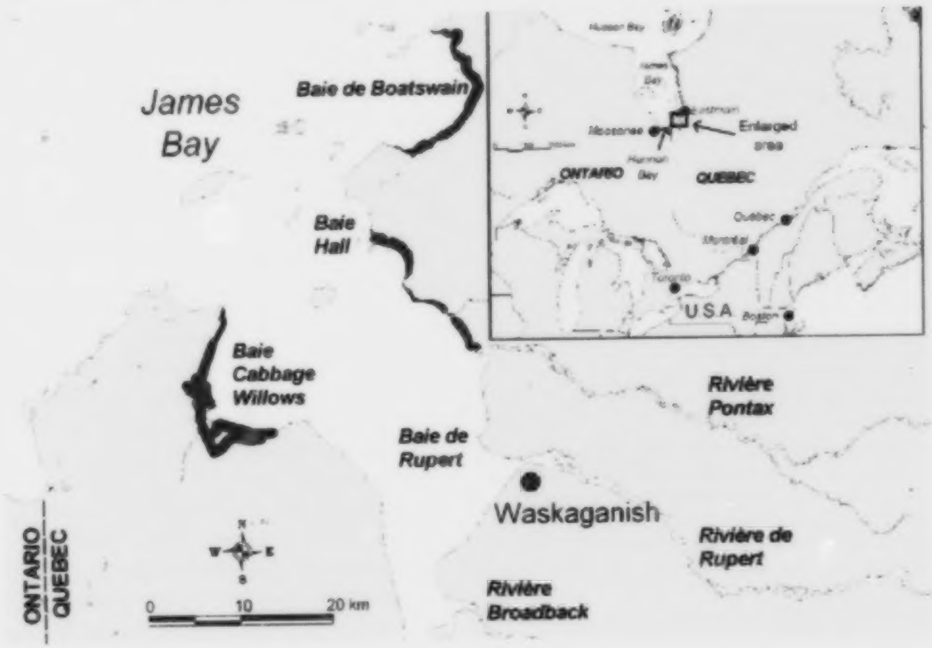

Figure 17. Location of baie Cabbage Willows, baie de Boatswain, and baie Hall, in southeastern James Bay, Quebec, where Yellow Rails were surveyed on 21–25 July 2002 during nighttime along line transects. The black strips represent the area covered by the surveys.

species (R.S.Q. c. E-12.01; Gazette officielle du Québec 2003). For this reason, the Yellow Rail has to be considered in environmental impact assessments. Thus, in 2002, Hydro-Québec invited Environment Canada's Canadian Wildlife Service (Quebec Region) to supervise and conduct a Yellow Rail survey in the marshes along the southeastern James Bay coast within the framework of the environmental impact assessment of the Eastmain 1-A Powerhouse and Rupert Diversion project. This article summarizes the survey in question, the results of which were recently published in the scientific periodical *Waterbirds* (Robert et *al.* 2004).

Overview of the field studies

Fieldwork was carried out in Quebec from 21 to 25 July 2002 in three brackish marshes along the southeastern James Bay coast. We conducted Yellow Rail surveys in the marshes of baie Cabbage Willows, baie Hall, and baie de Boatswain (Fig. 17), which consist of extensive intertidal herbaceous areas. We surveyed Yellow Rails by counting adult males along line transects crossing potential habitats for the species. We conducted the surveys at night (10:30 p.m. to 5:00 a.m.), when males typically call repeatedly, simply by walking and listening along the transects.

We also conducted a few daytime surveys to obtain information on other species considered to be at risk in Canada (Short-eared Owl [*Asio flammeus*]) or in Quebec (Nelson's Sharp-tailed Sparrow [*Ammodramus nelsoni*]). These daytime surveys allowed us to obtain additional information on the Yellow Rail.

With the help of geomatic tools and digital vegetation maps, we determined the area covered by our surveys, overlaying that with information on the different plant communities within the three marshes surveyed. We then calculated the density of Yellow Rails within each plant community and within each marsh and thus were able to

estimate the number of Yellow Rails for those portions of the marshes that we were not able to cover by line transects.

Overview of results

We surveyed the Yellow Rail along 75 km of line transects and heard 186 calling males: 80 in baie Cabbage Willows, 77 in baie de Boatswain, and 29 in baie Hall. We also heard 19 additional calling Yellow Rails during our daytime surveys (these surveys were conducted in different sectors than the nighttime surveys), bringing the total number of birds heard to 205. The overall density of Yellow Rails in the three marshes surveyed was 0.05 males per hectare, with maximum densities in baie de Boatswain (0.08 males/ha) and baie Hall (0.06 males/ha).

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The Yellow Rails inhabited marshes dominated by graminoid (i.e., filiform) herbaceous plants, where the soil was most often simply waterlogged rather than flooded by daily tides. The plant species particularly associated with the presence of Yellow Rails were slimstem reedgrass (*Calamagrostis stricta stricta*), chaffy sedge (*Carex paleacea*), buckbean (*Menyanthes trifoliata*), and red fescue (*Festuca rubra*).

Using the calculated densities in each type of habitat, we estimated that there were a total of 397 male Yellow Rails inhabiting the marshes surveyed: 216 in baie de Boatswain, 132 in baie Cabbage Willows, and 49 in baie Hall. A large proportion (57%) of rails were associated with plant populations dominated by buckbean (a surprising result; see Robert *et al.* 2004), whereas others were found within plant populations dominated by slimstem reedgrass (21%) or chaffy sedge (18%).

Discussion

Our results show that the Yellow Rail is a common bird in the three James Bay marshes visited during this study. We counted nearly 200 calling males during only five night surveys, and our calculations indicate that baie Cabbage Willows, baie de Boatswain, and baie Hall harbour about 400 male Yellow Rails. Such high concentrations of Yellow Rails have not been found anywhere else in the world, which shows the relative importance of these marshes for this species of special concern. The estimated Yellow Rail densities for these marshes are the highest ever reported in the literature. Our surveys were carried out in the three largest coastal marshes of southeastern James Bay. Our estimate (400 male Yellow Rails) may thus represent the bulk of the male population found on the Quebec side of James Bay. However, additional studies will be necessary to determine whether the Yellow Rails in this area are breeding individuals or are only visiting the area to moult.

The Ontario side of James Bay and Hudson Bay may also be of great importance for the Yellow Rail, according to the little information available (Peck and James 1983; Wilson and McRae 1993; Austen *et al.* 1994). This is especially the case for Hannah Bay, because it contains coastal marshes similar to those on the Quebec side and has areas that are nearly as large as those we surveyed during our study (Consortium Gauthier and Guillemette – G.R.E.B.E. 1992). In our opinion, the coastal marshes of southern James Bay, extending from Moosonee (Ontario) to Eastmain (Quebec), may well harbour 1000 adult male Yellow Rails at the end of July, a significant proportion of the species' world population. Fortunately, this important area also contains three migratory bird sanctuaries (Hannah Bay, Moose River, and baie de Boatswain), which undoubtedly cover a significant proportion of the potential Yellow Rail habitats in the region. In addition, the Government of Quebec recently designated two new protected areas in the region, namely the Ministikawatin Peninsula Biodiversity Reserve (including baie Cabbage Willows) and the Boatswain Bay Biodiversity Reserve. However, baie Hall does not benefit from any special protection.

Protecting these marshes is all the more important because other species of interest inhabit them. For example, we counted 413 Nelson's Sharp-tailed Sparrows, the largest number of individuals of this species ever reported in Quebec, in only a few mornings' surveys

of only a small portion of the area's potential habitats. We also estimated that there were at least eight Short-eared Owl territories in the areas we visited. Moreover, baie Cabbage Willows and baie de Boatswain are the only known Marbled Godwit (*Limosa fedoa*) nesting sites in Quebec, and they harbour the province's highest densities of nesting Sandhill Cranes (*Grus canadensis*).

Of course, much still has to be done before an overall picture of the avian fauna of the southern James Bay coastal marshes can be obtained. It is nonetheless surprising to note what just a few days spent in three of the region's marshes could reveal from an ornithological point of view. Given the relative importance of these marshes for the Yellow Rail and other species at risk, we are of the opinion that it would also be appropriate to give the baie Hall marsh protected status.

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Trends in "other" waterbirds

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In the last issue of *Bird Trends* that dealt with waterbirds, Ricky Dunn provided an article with the above title (Dunn 1996). Its purpose, if we may paraphrase, was to provide information on trends for "other" waterbirds — i.e., those birds associated with fresh water that are not waterfowl, shorebirds, or passerines. Some of these species are often well covered with special surveys, such as gulls, terns, cormorants, and herons, but others often fall through the cracks when it comes to reporting, because of either their secretive nature or difficult access to their nesting grounds, such as loons, grebes, cranes, and moorhens.

What long-term data we have for these species come, almost solely, from the Breeding Bird Survey (BBS), which has nearly a 40-year data set (1968–2006 in Canada) from which to draw. Although even the BBS does not adequately survey some of these species (e.g., Arctic-breeding loons (*Gavia spp.*), Great Egret (*Ardea alba*), Least Bittern (*Ixobrychus exilis*), King Rail (*Rallus elegans*), at present, it is the best single source of long-term data. The purpose of this short article is to provide an update on the status of "other" waterbirds that Dunn outlined for the period from 1968 to 1994. For this we have relied on an updated analysis of BBS data covering the period 1968–2005 (Downes *et al.* 2005, Sauer *et al.* 2005).

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The updated BBS analyses for the species listed by Dunn (1996) and a few additional species (n=34) are presented in Table 7. For all species, there were more Canadian BBS routes that recorded the species than there were during the 1968–1994 survey period (Table 7).

Those species exhibiting a significant decline (n=5, 15%) were American Bittern (*Botaurus lentiginosus*), King Rail, Common Moorhen (*Gallinula chloropus*), Herring Gull (*Larus argentatus*), and Great Black-backed Gull (*L. marinus*) (Table 7). The species showing a non-significant negative trend (n=13, 38%) were Horned Grebe (*Podiceps auritus*), Pied-billed Grebe (*Podilymbus podiceps*), Least Bittern, Black-crowned Night-Heron (*Nycticorax nycticorax*), Green Heron (*Butorides virescens*), Great Blue Heron (*Ardea herodias*), Franklin's Gull (*Larus pipixcan*), Bonaparte's Gull (*L. philadelphia*), Glaucous-winged Gull (*L. glaucescens*), Common Tern (*Sterna hirundo*), Arctic Tern (*S. paradisaea*), Forster's Tern (*S. forsteri*) and Black Tern (*Chlidonias niger*). While the negative trend was not significant for Forster's Tern, analyses were based on few BBS routes and the mean rate of decline was high (-6.1% annually); in spite of the 2005 BBS index being the highest recorded in 20 years (Downes *et al.* 2005), the short-term trend (1995–2005) is still a decrease of 10.1% per year, which justifies a cause for some concern for this species.

Those species showing a significant increase over the 1968–2005 period (n=6, 18%) were Common Loon (*Gavia immer*), Red-necked Grebe (*Podiceps grisegena*), Great Egret, Sandhill Crane (*Grus canadensis*), Ring-billed Gull (*Larus delawarensis*), and California Gull (*L. californicus*) (Table 7). There was insufficient data to establish a Canadian trend for the Great Egret; however, there was a significant positive trend for this species over the entire BBS survey area (Table 7) and the number of egret pairs breeding on the Canadian Great Lakes has increased steadily over the last decade (CWS unpubl. data). Those species showing non-significant positive trends (n=10, 29%) were Western and Clark's Grebes (*Aechmophorus occidentalis*) and (*A. clarkii*) (data pooled), Eared Grebe (*Podiceps nigricollis*), American White Pelican (*Pelecanus erythrorhynchos*), Double-crested Cormorant (*Phalacrocorax auritus*), Virginia Rail (*Rallus limicola*), Sora (*Porzana carolina*), Yellow Rail (*Coturnicops noveboracensis*), American Coot (*Fulica americana*), Mew Gull (*Larus canus*), and Caspian Tern (*Sterna caspia*).

Five species (15%; American White Pelican, Great Egret, Sandhill Crane, Yellow Rail, California Gull) exhibited an increased positive trend since Dunn (1996), while annual declines appear to have stabilized for an additional six species (18%; Horned Grebe, Eared Grebe, Pied-billed Grebe, Sora, American Coot, Black Tern).

Those species whose status was maintained (i.e., no change; n=10, 29%) since Dunn (1996) were: Common Loon, Double-crested Cormorant, Red-necked Grebe, Least Bittern, Virginia Rail, Franklin's Gull, Bonaparte's Gull, Ring-billed Gull, Common Tern and Caspian Tern.

The status of 10 species (29%) has deteriorated since Dunn (1996). The American Bittern, King Rail, Common Moorhen, Herring Gull and Great Black-backed Gull all changed from a non-significant trend to significant negative trend, while the Great Blue Heron, Glaucous-winged Gull and Forster's Tern changed from a positive trend to a non-significant negative one. In addition, both the Black-crowned Night-Heron and the Green Heron exhibited a qualitative deterioration in status in the more recent data set (change from a non-significant positive trend to a non-significant negative one).

The overall patterns for two taxonomic groups warrant comment. Five of the six heron species exhibited at least a qualitative negative trend in Canada, and the BBS index has declined for four of these since Dunn (1996); only the Great Egret has shown an improvement. Among gulls and terns, the BBS index for the Ring-billed Gull and the California Gull increased, while the remaining eight species showed a negative trend (established for Herring Gull and Great Black-backed Gull, non-significant for the other species).

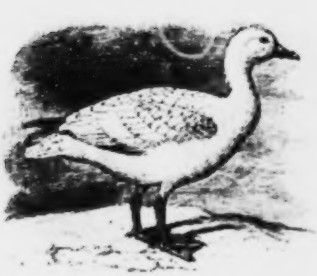
Table 7. Canadian BBS trends in "other" waterbirds during the period 1968–1994 (adapted from Dunn 1996) and 1968–2005.[a,b,c]

		1968–1994		1968–2005	
Species	**Latin name**	**Canadian BBS routes (*N*)**	**Trends**	**Canadian BBS routes (*N*)**	**Trends**
Common Loon	***Gavia immer***	**338**	**+**	**501**	**+**
Western/Clark's Grebe	*Aechmophorus spp.*	nd		44	0
Red-necked Grebe	***Podiceps grisegena***	**78**	**+**	**140**	**+**
Horned Grebe	*Podiceps auritus*	100	?	138	?0
Eared Grebe	***Podiceps nigricollis***	**66**	**?0**	**97**	**0**
Pied-billed Grebe	*Podilymbus podiceps*	174	?	284	?0
American White Pelican	***Pelicanus erythrorhynchos***	**43**	**0**	**76**	**++n**
*Double-crested Cormorant	*Phalacrocorax auritus*	[60]	[++n]	208	++n
Least Bittern	***Ixobrychus exilis***	**(28)**	**(?0)**	**(43)**	**(?0)**
American Bittern	*Botaurus lentiginosus*	317	?0	443	?
Black-crowned Night-Heron	***Nycticorax nicticorax***	**75**	**+0**	**110**	**?0**
Green Heron	*Butorides virescens*	65	+0	90	?0
Great Blue Heron	***Ardea herodias***	**330**	**+**	**507**	**?0**
Great Egret	*Ardea alba*	(368)	(+0)	(607)	(+)
Sandhill Crane	***Grus canadensis***	**69**	**+**	**165**	**++**
King Rail	*Rallus elegans*	-26	(?0)	-38	(??)
Virginia Rail	***Rallus limicola***	**46**	**0**	**86**	**0**
Sora	*Porzana carolina*	253	?0	391	0
Yellow Rail	***Coturnicops noveboracensis***	**15**	**0**	**33**	**0**
Common Moorhen	*Gallinula chloropus*	-97	(+0)	22	??
American Coot	***Fulica americana***	**158**	**?**	**232**	**0**
Franklin's Gull	*Larus pipixcan*	119	?0	179	?0
Bonaparte's Gull	***Larus philadelphia***	**47**	**?0**	**76**	**?0**
*Ring-billed Gull	*Larus delarwarensis*	[190]	[+]	428	+
***Mew Gull**	***Larus canus***	**nd**		**42**	**0**
*Herring Gull	*Larus argentatus*	[141]	[-0]	330	?
***California Gull**	***Larus californicus***	**[37]**	**[++0]**	**99**	**++**
*Great Black-backed Gull	*Larus marinus*	[44]	[-0]	92	??
***Glaucous-winged Gull**	***Larus glaucescens***	**-31**	**(+)**	**29**	**?0**
*Common Tern	*Sterna hirundo*	[55]	[-0]	171	?0
***Arctic Tern**	***Sterna paradisaea***	**nd**		**28**	**?0**
Forster's Tern	*Sterna fosteri*	-88	(+)	31	??0
Black Tern	***Chlidonias niger***	**167**	**?**	**238**	**?0**
*Caspian Tern	*Sterna caspia*	-59	(+0)	33	0

* Species not included in Dunn (1996).

[a] Symbols: nd = no data available; "+" or "?" indicates a trend change of up to 5% per year; "++" or "??" indicates a trend change of >5% per year; "n" denotes a non-significant trend where 0.15 > p > 0.05; trends followed by a "0" indicate a non-significant change in the direction shown by the sign. [b] Round parentheses indicate that North American trends were reported (Sauer et al. 2005), as there were insufficient data with which to establish a separate Canadian trend; square parantheses indicate Canadian trends, taken from Sauer et al. (2005); otherwise, 1968-1994 data are from Dunn (1996) and 1968-2005 are from Downes et al. (2005). [c] Waterbird species not included in the table, for which there were insufficient data to establish a Canadian or North American trend; Yellow-billed Loon (*Gavia adamsii*), Pacific Loon (*Gavia pacifica*), Red-throated Loon (*Gavia stellata*) and Whooping Crane (*Grus americana*).

Of the waterbird species covered, 47% exhibited at least a qualitative positive trend, and 33% of species showed an improvement in status since Dunn (1996). The results of the BBS indicate long-term declines in Canada for American Bittern, Common Moorhen, Herring Gull, Great Black-backed Gull, and at a continental level for King Rail. Potential declines in Forster's Tern also warrant concern, as the rate of annual decline appears to be high and monitoring of this species is somewhat limited. Efforts should be made to determine the causes of these declines. Two of the taxonomic groups covered (larids and herons) exhibited group-wide negative trends, suggesting that similar ecological factors may be affecting the species within each of these groups (i.e. species that share life history traits). In addition, attention should be focused on species represented by few BBS routes (e.g., Western and Clark's Grebes, Yellow Rail, Common Moorhen, Forster's Tern) or for which there are no reliable trend data for Canada [e.g. Yellow-billed (*Gavia adamsii*), Pacific (*G. pacifica*), and Red-throated loons (*G. stellata*), Great Egret, Whooping Crane (*Grus americana*)]. Many of these species were identified by Dunn (1996) as those for which we knew little regarding their population status in 1994. A decade later, many of these knowledge gaps still exist.



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Acknowledgements

We thank Martin Damus for providing the results of the analysis of the 1968–2005 BBS data, a copy of Dunn (1996) and for comments on previous versions of this paper.

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Control of the Greater Snow Goose population through changes to sport harvest regulations: Effects on hunting mortality and survival rates

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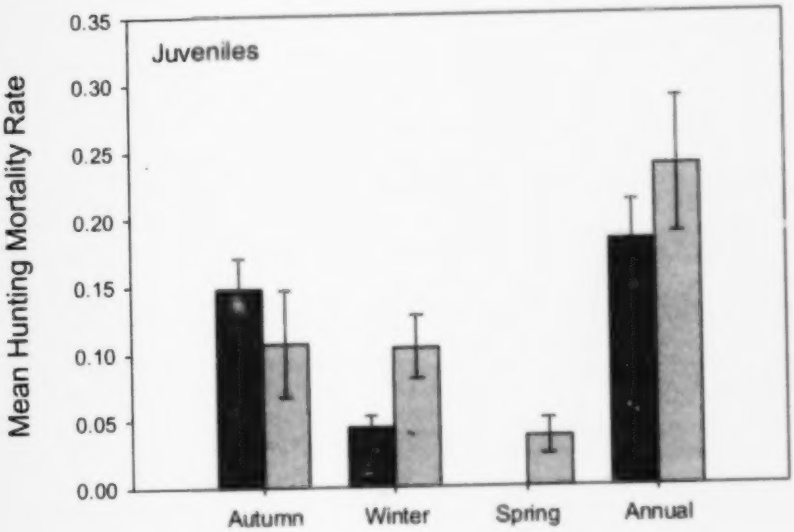
While many migratory bird populations are in need of protection to prevent further declines or even extinction, some others that are able to respond quickly to beneficial human actions are growing at unusually high rates. For example, many North American goose populations have shown extraordinary growth over the past few decades (Ankney 1996), despite most of these populations being frequent sport hunting targets (CWS Waterfowl Committee 2001a). These population increases have been particularly rapid in "light geese" and have been attributed to human sources: development of hunting-free refuges for threatened species, declining hunting pressure, climate change, and widely available crop residue that is a good food source during migration (Ankney 1996; Batt 1997, 1998; Gauthier *et al*. 2005). Rapid growth of the midcontinent population of the Lesser Snow Goose (*Chen caerulescens caerulescens*) subspecies was of particular concern for wildlife managers, because feeding by the overabundant geese caused serious damage to their Arctic wetland breeding sites (Abraham and Jefferies 1997).

The Greater Snow Goose (*C. c. atlantica*), a subspecies that breeds throughout the eastern Canadian Arctic and winters along the Atlantic coast of the United States, has also demonstrated remarkable population growth in recent decades. Between 1983 and 1997, the population increased by an average of 9.7% per year, a rate that caused wildlife managers to worry that this population might damage Arctic ecosystems in the same way the Lesser Snow Goose had already done (Giroux *et al*. 1998a). In addition, the population's distribution and hunting pressure have changed in recent years (Reed *et al*. 1998; Calvert *et al*.



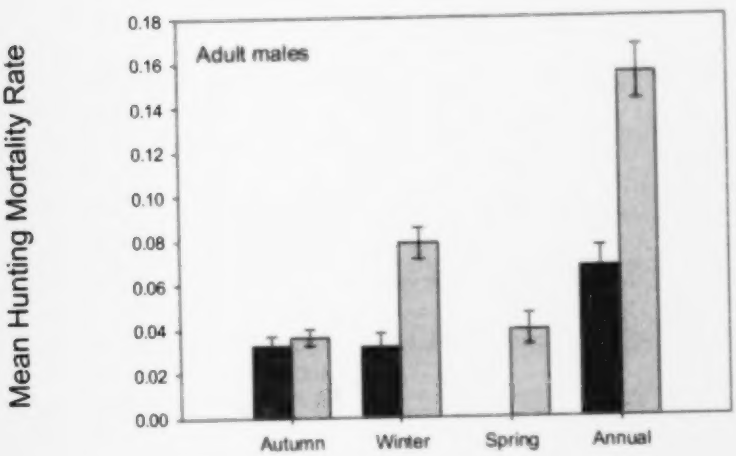


Figure 18. Greater Snow Goose hunting mortality rates before (1990–1998, dark grey) and after (1999–2002, light grey) the implementation of the special conservation measures (mean ± SE) for adult males and juveniles (sexes pooled) (from Calvert and Gauthier 2005); adult females showed very similar trends to adult males.

2005), with unknown consequences for its management. Research showed that the population growth rate was most sensitive to changes in adult survival (Gauthier and Brault 1998), and several potential conservation measures were proposed with the goal of reducing adult survival to ultimately stabilize the Greater Snow Goose population size (Giroux et *al.* 1998b). Hunting mortality is closely linked to adult survival in this group of geese (Gauthier et *al.* 2001), so the recommendations focused on hunting as a tool to manage the population.

Following the recommendations presented by the Arctic Goose Habitat Working Group (Batt 1998), new conservation measures were implemented for the Greater Snow Goose beginning in the 1998–1999 season. These included the liberalization of the existing autumn hunting season in Quebec and the winter

hunting season in the Atlantic Flyway states, allowing larger bag and possession limits and hunting methods that were previously prohibited, as well as the implementation of a spring conservation harvest in Quebec (CWS Waterfowl Committee 2001a,b). Given that all pre-breeding harvest of migratory birds has been prohibited in North America since the signing of the Migratory Birds Treaty in 1916, this latter measure was considered particularly drastic and was expected to have the largest effect on the population.

In order to fully assess the effects of these new conservation measures, it was essential to understand whether survival and hunting mortality rates were affected as expected by the changes to hunting regulations. We also wanted to be able to separate the effects of the spring conservation harvest from those of the regular autumn and winter hunting season liberalizations. In combination with the results of other studies that have demonstrated the consequences of these new hunting regulations for migration and reproduction (Mainguy *et al.* 2002; Béchet *et al.* 2003, 2004; Féret *et al.* 2003; Reed *et al.* 2004), knowledge of the implications for survival and mortality is critical for managing this population in the future.

Our analyses provided insight into the sources of variation in survival and mortality rates, as well as the specific impact of the changes to hunting regulations (see Calvert and Gauthier 2005). We found that annual hunting mortality rates were higher for juveniles than for adults, a common result in geese. However, the new regulations caused a large increase in annual hunting mortality of adults but only a marginal change in juveniles (Fig. 18). In accordance with this result, we found no evidence for a change in juvenile survival probability with the new regulations, but instead high annual variability both before and after these changes were implemented (overall, the annual survival rate of young averaged 45%). Adults, however, showed a decline in annual survival rate after the new regulations took effect, down to 73% (average adult survival 1999–2002) from 83% (1990–1998). The 83% survival measure corresponded very well with an independent estimate made for adult female Greater Snow Geese (Gauthier *et al.* 2001), supporting the estimates obtained in this comparison. We found little evidence for any sex-related differences in survival or mortality of either adult or juvenile geese.

In order to estimate seasonal hunting mortality rates, we developed a mathematical model to estimate the probability that a bird would be killed by a hunter in a particular hunting season within a year, conditional on the probability that it was *not* killed during a previous season in the same year. The model provided us with separate estimates of seasonal hunting mortality rates for juveniles, adult males, and adult females for each year. We found that while the new spring conservation harvest did contribute to the overall increase in hunting mortality observed in this population, it was not the sole contributor. Winter hunting mortality in Atlantic Flyway states increased notably for both age groups, but autumn hunting mortality in Quebec showed little change with the new measures in either adults or juveniles (Fig. 18). These seasonal estimates showed that it was both the spring harvest and the changes to winter regulations that contributed to the increase in annual hunting mortality and the corresponding reduction in adult survival. Although we cannot rule out the possibility that autumn mortality rate could have been slightly underestimated due to some biases in reporting rates (see Calvert and Gauthier 2005), it appears that the spring conservation harvest and the winter liberalization have been the most effective of the new regulations for attaining the goal of reducing adult survival.

The spring conservation harvest was intended simply as a temporary, extraordinary measure (K.M. Dickson, pers. comm.). Since the implementation of this measure and the others during the regular seasons, the abundance of Greater Snow Geese has declined (Canadian Wildlife Service, unpubl. data). However, given that the original causes of the growth in abundance are still present (e.g., agricultural foods, refuges), the possibility remains that this population will resume its growth if the spring harvest is stopped. Consequently, the need for each

of these conservation measures is currently being reassessed to determine the appropriate course of action to maintain the population at an acceptable level. Our findings suggest that future control of the abundance of this population may be possible through manipulation of regular season harvests, particularly during winter in the Atlantic Flyway states. In addition, the modelling approach that we used to separate hunting mortality rates into seasonal components could be useful in the management of other hunted populations that migrate through several jurisdictions subject to different harvest regimes.

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Population trends of colonial waterbirds nesting on/near the wildlife islands in Hamilton Harbour 1997–2004

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Colonial waterbirds began breeding in Hamilton Harbour, at the western end of Lake Ontario, during the 1970s (Dobos *et*

Table 8. Results of temporal trend analysis by species, slope of regression equation (1997–2004), and number or percentage of nests (in 2004) on the wildlife islands and in Hamilton Harbour, Lake Ontario.

Species	Study area	Number of nests in 2004[b]	Slope (change in number of nests per year)[a]	Percentage of nests in 2004[b]	Slope (change in percentage of nests per year) (%)
Double-crested Cormorant	Wildlife islands	36	3.07**	1	<1
Black-crowned Night-Heron	Wildlife islands	101	5.69	45	-7.22
Herring Gull	Wildlife islands	78	1.77	31	1.36
Ring-billed Gull	Wildlife islands	2 476	426**	11	1.19
Caspian Tern	Wildlife islands	415	-1.84	100	0.95
Common Tern	Wildlife islands	218	?23.6	41	-1.15
Double-crested Cormorant	Hamilton Harbour	2 482	250**	100	
Black-crowned Night-Heron	Hamilton Harbour	224	19.96**	100	
Herring Gull	Hamilton Harbour	253	-8.18	100	
Ring-billed Gull	Hamilton Harbour	21 901	606	100	
Caspian Tern	Hamilton Harbour	415	-2.80	100	
Common Tern	Hamilton Harbour	529	-30.25	100	

[a] ** = statistically significant trend.

[b] = For example, in 2004, there were 36 Double-crested Cormorant nests on the wildlife islands and 2482 in Hamilton Harbour; therefore, 1% (36/2482) of the nests were on the wildlife islands in 2004.

al. 1988). Since then, breeding populations have grown, such that Hamilton Harbour has become one of the most important nesting areas on the Great Lakes for colonial waterbirds (Moore *et al.* 1995; Blokpoel and Tessier 1996; Morris *et al.* 2001). Data from the most recent binational census of colonial waterbirds nesting on the Great Lakes (1997–2000) showed that colonies in Hamilton Harbour supported 11% of colonial waterbirds nesting on Lake Ontario. Colonies in Hamilton Harbour are particularly important for Caspian Terns (*Sterna caspia*) and Common Terns (*S. hirundo*), since 20% and 51%, respectively, of the Lake Ontario nesting populations are in Hamilton Harbour (Cuthbert *et al.* 2001; Pekarik *et al.* 2003; Canadian Wildlife Service, unpubl. data).

During the winter of 1995–1996, three wildlife islands were constructed in the northeast corner of Hamilton Harbour, since one of the main nesting areas for colonial waterbirds elsewhere in the harbour area was slated for development. Habitats on the islands were designed and created to accommodate six species of colonial waterbirds: Double-crested Cormorant (*Phalacrocorax auritus*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Herring Gull (*Larus argentatus*), Ring-billed Gull (*L. delawarensis*), Caspian Tern, and Common Tern (Quinn *et al.* 1996; Pekarik *et al.* 1997). Since construction, management strategies have been employed to maintain biodiversity on the islands. Strategies include the laying of plastic sheeting on nesting areas of Common and Caspian terns in early spring to discourage nesting by earlier arriving Ring-billed Gulls and the use of tethered raptors to dissuade Ring-billed Gulls from nesting and loafing on Common Tern nesting areas. The purpose of this report is to present trends in the populations of the six species of colonial waterbirds nesting on the wildlife islands and to assess the proportion of nests on the islands relative to the total number of nests within Hamilton Harbour.

Results of regression analysis for nesting populations on the wildlife islands and in the Hamilton Harbour area (1997–2004) are in Table 8, along with the percentage of nests on the wildlife islands. The numbers of Double-crested Cormorants and Ring-billed Gulls have increased significantly on the wildlife islands during the period of analysis. The numerical

increase in nesting Ring-billed Gulls has complicated efforts to maintain habitat for Common Terns that compete with Ring-billed Gulls for nesting areas. The number of Double-crested Cormorants has also increased significantly within Hamilton Harbour. In 2004, cormorants nested in trees on the wildlife islands above Black-crowned Night-Herons; if this continues, it could lead to defoliation and death of the trees and abandonment by Black-crowned Night-Herons. The number of Black-crowned Night-Heron nests has also increased significantly in the harbour; however, the proportion of birds nesting on the wildlife islands showed a negative trend. The number of Herring Gull nests on the wildlife islands has been increasing, in contrast to a decline harbour-wide by approximately eight nests per year (Table 8).

Overall, the wildlife islands have provided essential nesting habitat for the intended species. The islands support significant proportions of Caspian and Common tern nests within Hamilton Harbour, and this represents large percentages of the Lake Ontario populations for these species. On the wildlife islands, the significant increasing trends observed for Ring-billed Gulls and Double-crested Cormorants and non-significant decreasing trends for Caspian and Common terns indicate that monitoring and management of these colonies will continue to be required. Although the number of Ring-billed Gull nests has been increasing on the wildlife islands while management was being employed, their nesting sites elsewhere in the harbour have been undergoing continued commercial development, placing increased pressure on many Ring-billed Gulls to find nesting sites elsewhere in the harbour. Owing to the competition that this creates for limited nesting sites on the wildlife islands, ongoing management will be required in order to maintain available nesting habitat for Caspian and Common terns.

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The rise and fall of the Port Colborne (Lake Erie) Common Tern colony: A case study in conservation biology

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Common Terns Sterna hirundo *are in trouble on the Canadian Great Lakes*

Census data collected by the Canadian Wildlife Service and the U.S. Fish and Wildlife Service in the Canadian and U.S. waters of the Great Lakes show that serious declines in numbers of Common Tern nesting pairs have occurred over the recent past and that these declines are primarily a function of losses at sites in Canadian waters. In contrast, Common Tern numbers at colonies in U.S. waters were stable over the same period (Table 9). The greatest changes in nest numbers were on Lake Erie, where

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Table 9. Numbers of breeding pairs of Common Terns and number of colony sites (in parentheses) in Canadian and U.S. waters of the Great Lakes between 1976 and 1998.[a]

Water body	1976–1977	1989	1997–1998
Canada (1976, 1989, 1998)			
St. Lawrence River	**188 (7)**	**65 (7)**	**116 (5)**
Lake Ontario	1 299 (5)	1 159 (6)	1 194 (11)
Lake Erie	**1 524 (4)[b]**	**1 135 (2)**	**540 (1)**
Detroit River	159 (1)	0 (0)	4 (1)
Georgian Bay	**2 320 (32)**	**2 318 (34)**	**1 829 (16)**
Lake Huron (main lake)	326 (8)	330 (5)	134 (9)
Lake Huron (North Channel)	**2 750 (31)**	**1 519 (17)**	**1 911 (19)**
Lake Superior	0 (0)	25 (1)	0 (0)
Subtotal	**8 566 (88)**	**6 551 (72)**	**5 728 (62)**
United States (1977, 1989, 1997)			
Lake Ontario[c]	**5 (1)**	**67 (2)**	**11 (2)**
Niagara River[d]	518 (3)	160 (3)	113 (4)
Lake Erie[d]	**263 (1)**	**644 (5)**	**909 (5)**
Detroit River	20 (1)	0 (0)	0 (0)
Lake St. Clair	**120 (1)**	**55 (1)**	**0 (0)**
Lake Huron	364 (8)	257 (3)	244 (2)
Lake Michigan	**753 (13)**	**1 054 (9)**	**437 (8)**
St. Marys River	246 (5)	344 (9)	628 (1)
Lake Superior	**328 (5)**	**257 (2)**	**316 (2)**
Subtotal	2 617 (38)	2 838 (34)	2 658 (24)
Great Lakes total[c]	**11 183 (126)**	**9 389 (106)**	**8 386 (86)**

[a] Data are from Scharf *et al.* (1978), Scharf and Shugart (1998), Blokpoel and Tessier (1996), Cuthbert *et al.* (2001), and Pekarik *et al.* (2003).

[b] Two colonies at Port Colborne: 562 nests — breakwater; 938 nests — mainland peninsula (numbers are the maximum counts recorded during two count periods).

[c] Colonies in upper St. Lawrence to Massena, New York, not visited or counted in first census; 601 nests (17 sites) in second census; 663 nests (29 sites) in third census.

[d] Buffalo Breakwater considered as a Niagara River site by Scharf *et al.* (1978) and Scharf and Shugart (1998) and as a Lake Erie site by Cuthbert *et al.* (2001).

numbers at Canadian colonies declined at an annual rate of -4.6%, whereas those at U.S. colonies increased at an annual rate of +6.4%.

Two major Common Tern colonies were recorded near Port Colborne, Ontario, in the 1976 census of Lake Erie. One colony was on the east leg of a breakwater built to protect ships entering the Welland Canal; the second was on a peninsula of land on the east side of the canal (Fig. 19). These two sites supported nearly all (98.4%) of the 1524 nests recorded on the Canadian coast of Lake Erie during the first census. By the second census in 1989, terns had abandoned the peninsula site (reasons unknown), but 935 of the 1135 (82.4%) nests recorded on Lake Erie were on the breakwater. By the third census in 1998, all 540 nests recorded on the Canadian coast of Lake Erie (Table 9) were on the breakwater. These numbers confirm the importance of the Port Colborne site(s) for Common Terns on the lower Great Lakes.

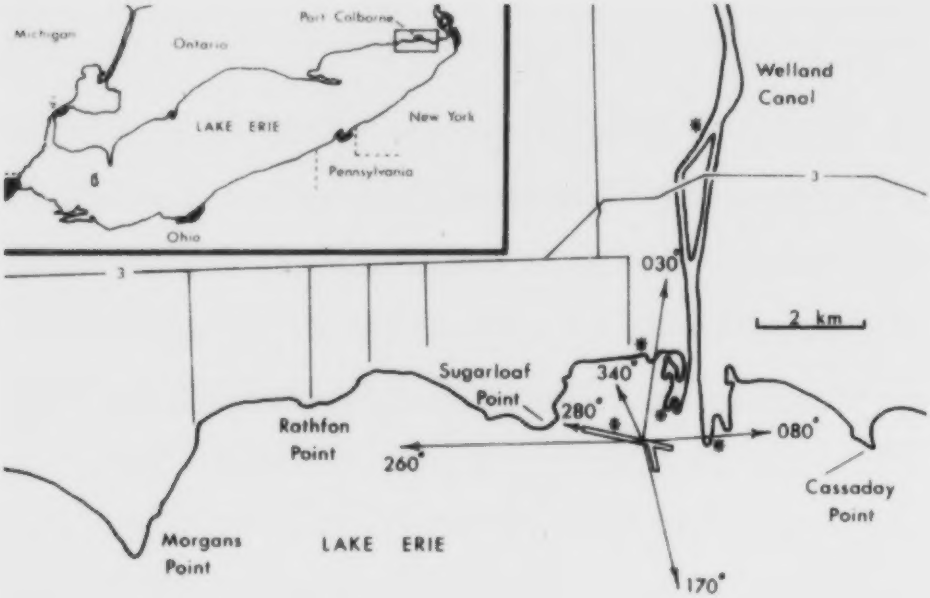

Figure 19. The north shore of Lake Erie at Port Colborne, Ontario. The arrow indicates the location of the Common Tern colony on the east leg of the breakwater associated with the Welland Canal.

The Port Colborne Common Tern colony

The breakwater (Fig. 19) is owned and maintained by the St. Lawrence Seaway Authority. Built in the early 1900s, the breakwater has served as a nesting site for Common Terns since the early 1920s (J. Bonisteele, pers. comm.). By the early 1970s, the concrete substrate on the east shelf was badly weathered; the chipped pieces of concrete, while ideal for tern nest construction, were an indication to the Seaway Authority of structural weakness. Accordingly, the wall was repaired in the summer of 1987, after which the loose concrete chips were replaced on the scarified surface, in the hope that this would preserve the original substrate at the site; however, a severe winter storm on Lake Erie in December 1987 raised the water level at the east end of the lake and washed all the loose chip material off the wall. This loss of material has required the annual addition and maintenance of nesting substrate (pea-sized gravel) for use by terns.

Common Terns arrive at the site around the middle of April, and most clutch starts occur during the second week of May (Fig. 20). Ring-billed Gulls (*Larus delawarensis*), however, arrive at the site in mid-March, and their egg laying begins during the first week of April and continues throughout the month, with most clutches initiated during the middle part of April. In the absence of management procedures that favour terns, the substrate along the east leg of the breakwater would be completely occupied by incubating gulls by the time terns began selecting their nest sites.

Since 1977, I have annually counted the number of Common Tern clutches at the breakwater colony during the third week of May (Fig. 21). After increases in the first few years, the numbers steadily declined; the apex lies coincident with the repair of the breakwater. The reduction in number of nesting pairs was especially rapid over the last 7 years, with a final count of 140 clutches in 2004; more significant than this low number of clutches was the complete nesting failure of all tern pairs at the site in that year, an event never previously recorded. Despite efforts to

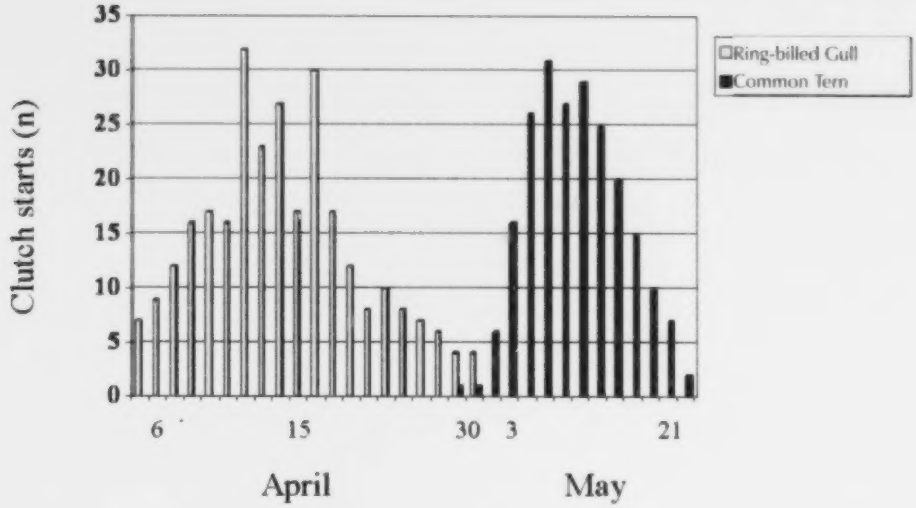

Figure 20. The distribution of clutch initiation by Ring-billed Gulls and Common Terns at the Port Colborne breakwater colony in 1982 (terns continued laying clutches beyond 21 May). The approximate 3-week interval between the first gull clutch and the first tern clutch is normal for this location in each year.

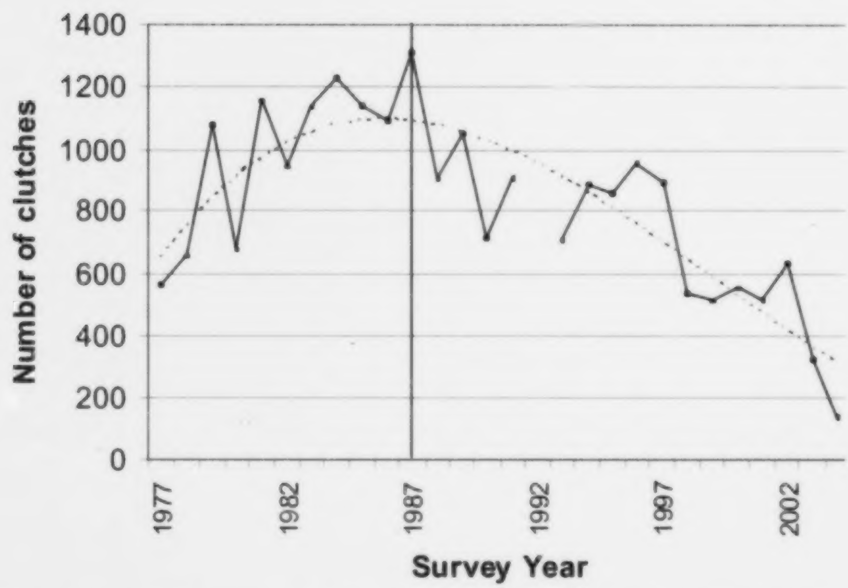

Figure 21. Numbers of Common Tern clutches counted at the Port Colborne colony. Count dates varied between 7 May and 3 June, with an average count date between 23 and 24 May. There was no count in 1992. The breakwater repair took place in July 1987 (vertical line). The dotted line represents a trinomial smoothing of the data (R^2 = 0.73).

Table 10. The number of Common Tern clutches counted on 22–23 May in the years noted on Spur Dyke in Windermere Basin, Hamilton Harbour, Ontario. Circumstances associated with the count in each year are noted.

Year	Clutches (n)	Circumstances at the colony
1998	339	Daily presence of a research worker in April and May[a]
1999	363	Daily presence of a research worker in April and May[a]
2000	295	Periodic and irregular removal of gull eggs
2001	289	Periodic and irregular removal of gull eggs
2002	227	Periodic and irregular removal of gull eggs
2003	337	Raptor on island throughout April
2004	301	Raptor on island throughout April

[a] Included management control of Ring-billed Gull presence and eggs.

protect even a few nests by enclosing them with wire-mesh fences, eggs were lost within a few days of laying. The best guess is that a mink or a weasel (*Mustela spp.*) was resident on the wall in the spring of 2004 and visited the tern colony on a regular basis, consuming all eggs present during each visit; however, the primary egg predator was never positively identified. Two different mink were resident in the rock pile to the west of the tern colony in earlier years but were removed whenever they were known to be entering the tern colony.

Management at the Port Colborne colony

During the course of other research by members of the Brock Seabird Group, management procedures to preserve and protect tern pairs were tested. These included nesting substrate enhancement (Richards and Morris 1984), placement of chick shelters (Burness and Morris 1992), and control of Ring-billed Gull intrusion (Morris et *al.* 1992). Substrate enhancement and gull control procedures were conducted each year.

Gull control involved visits every second day to disturb gull nests and to collect and dispose of gull eggs (under permit). When necessary, predatory mammals and adult gulls were removed following receipt of the appropriate federal and provincial permits.

Winter storms on Lake Erie wash large amounts of gravel off the breakwater shelf and into the lake; thus, the annual rehabilitation of substrate has been required, including replacement of gravel, planting low-growing vegetation such as mossy stonecrop (*Sedum acre*) to stabilize the substrate, and distributing flotsam material to provide cover relief for nesting adults and mobile chicks.

Colony designation as an Important Bird Area (IBA)

Although Common Terns were the primary justification for seeking the designation of the Port Colborne colony as an IBA, other colonial nesting waterbirds contribute to the avian biodiversity of the site. Ring-billed Gulls and Herring Gulls (*Larus argentatus*) have a long history of nesting on the rock pile portion of the breakwater at the intersection of the south and east legs to the west of the tern colony. Small numbers (4–6 pairs) of Black-crowned Night-Herons (*Nycticorax nycticorax*) nested in 2001, 2002, and 2003 in low willows at the west end of the rockpile (but abandoned the site in 2004). In 2004, about 60 pairs of Double-crested Cormorants (*Phalacrocorax auritus*) nested for the first time in poplar trees, also at the west end of the rock pile.

With the support of the Port Colborne Town Council, the Port Colborne and District Conservation Club, the Bert Miller Nature Club of Fort Erie, and the Niagara Falls Nature Club, the area was officially dedicated an IBA on 15 July 2001 at a lake-edge ceremony attended by municipal, provincial, and federal

politicians. The local volunteer group ("Friends of the Terns") took over enthusiastic "ownership" of the tern colony on that date and accepted the conservation plan (Wilson and Cheskey 2001) associated with it.

The future of the Port Colborne Common Tern colony

Unfortunately, local extinction of the Common Tern colony on the breakwater at Port Colborne is predictable. The decline in number of nests that began in 1988 continued thereafter despite the conscientious substrate rehabilitation and gull egg removal activities by members of the Brock University Seabird Group and (since 2000) the "Friends of the Terns" volunteer group.

There are several reasons for the continued decline. The annual rehabilitation of suitable substrate on the concrete base was a successful management procedure that provided suitable nesting substrate for Common Terns upon their arrival at the site each spring. However, efforts to prevent Ring-billed Gulls from nesting on the substrate prepared for Common Terns were increasingly unsuccessful. Beginning most noticeably in the spring of 1998, increasing numbers of Ring-billed Gulls established nesting territories on the substrate in April each year, and major efforts to remove gull eggs and clutches did not discourage gulls from abandoning their established nesting territories. As gulls became established on the east leg of the wall, the area of nesting substrate available for terns was successively diminished each year.

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A significant related problem was the presence each year of one or two Ring-billed Gull individuals that specialized in tern eggs as a food source; these were identified and removed when terns began laying eggs. Similarly, time-intensive effort to identify and remove the presumed mammal egg predator(s) in 2004 might have permitted some tern pairs to raise chicks in that year. Procedures to remove the individual(s) may have succeeded; however, a similar problem with a mink on the breakwater in 1992 required 24 hours per day observation for a week to finally remove the predator. Expecting volunteers, however dedicated, to give the time and effort to control such predation events is unrealistic.

Other efforts to conserve and manage Common Tern colonies have been conducted elsewhere on the Canadian Great Lakes: Blokpoel *et al.* (1997) used overhead wires and monofilament lines to exclude Ring-billed Gulls and temporarily restore a Common Tern colony on a small island in the St. Lawrence River. They also documented the extensive procedural and technical effort required to control numbers of nesting Ring-billed Gulls at urban and industrial sites in southern Ontario (Blokpoel and Tessier 1986). In each of these cases, successful control of gull nests at both natural and artificial sites required a major commitment each year. Elsewhere, the City of Hamilton permitted placement of a raptor at the Spur Dyke tern colony during the month of April, a recommendation proposed during construction of new waterbird nesting habitat in Hamilton Harbour (Quinn *et al.* 1996). Placement of a raptor in these years (2003 and 2004) was coincident with a return to numbers of tern nests in excess of 300 clutches (Table 10).

Although a major Common Tern colony will very likely be lost at the Port Colborne site, terns will continue to nest in the Niagara Peninsula at least into the near future. Buffalo Harbor is located at the east end of Lake Erie at the headwaters of the Niagara River, and three breakwaters in Buffalo Harbor have sustained Common Tern colonies since the first Great Lakes census in 1977. As Buffalo Harbor is approximately 35 km east of the Port Colborne site, it seems reasonable to assume that Port Colborne birds moved to Buffalo Harbor. While small numbers of Ring-billed Gulls nested at the Buffalo Harbor tern nesting sites in 2004, management protocols were successfully used to protect nesting terns (L. Harper, pers. comm.).

Editor's Note

Two additional years of data are available since the article was written. An estimated 36–40 tern pairs initiated clutches in May 2005 but despite their continued attempts

into early July to replace eggs lost to (presumed) predation, no chicks were hatched. In 2006, the Town of Port Colborne provided funding to place two raptors on the tern substrate in April. Raptors successfully prevented Ring-billed Gulls from occupying the substrate but were removed on 28 April when 6–8 terns were sighted in the area. An estimated 12–17 tern pairs appeared to be incubating eggs at the colony on 1 June. The fate of these clutches is unknown.

Acknowledgements

I acknowledge the "Friends of the Terns" volunteer group, in particular Alfred Marinelli of Port Colborne, who gave his best efforts to coordinate other members of the group and to get the job done. I thank Lee Harper for providing details of Common Tern nest numbers at the Buffalo Harbor colonies. I also thank Bruce Tkachuk (St. Lawrence Seaway Authority) for permission to access the Port Colborne breakwall and Al Dore (City of Hamilton) for funding raptor placement on Spur Dyke in Windermere Basin. Hans Blokpoel, Martin Damus, and Chip Weseloh provided helpful comments on early drafts of this paper.

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Double-crested Cormorants on the lower Great Lakes: a 2004 update on nest numbers and management actions

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The Great Lakes–wide population of breeding Double-crested Cormorants (*Phalacrocorax auritus*) has increased dramatically in the last 30 years. In a previous issue of *Bird Trends* (Weseloh 1996), that growth in cormorant breeding populations was documented as follows:

1973:	114 nests (=pairs)
1979:	654+ nests
1991:	38 000 nests
1994:	54 000 nests

In 2000, the Great Lakes–wide breeding population was estimated at 115 000 nests (pairs) (Weseloh *et al.* 2002). Since that time, there has not been another Great Lakes–wide survey or population estimate. However, we can document more recent changes on an individual lake basis, especially for the lower Great Lakes. Recent nest numbers (to the nearest 100) for Double-crested Cormorants on Lake Ontario and Lake Erie are given in Table 11.

Along with these large numbers of nests (pairs) and continued growth, various management concerns for cormorants have become high-priority issues. As described in 2002, the three main management issues for cormorant

Table 11. Number of Double-crested Cormorant nests in the lower Great Lakes, 1994–2004.

Year	Number of nests	
	Lake Erie	Lake Ontario
1994	5100	9600
1996	7200[a]	17 000
1999	9000+	20 100
2001	13 500	25 400
2002	15 000	28 200
2003	Not available	24 100
2004	18 900	26 200

[a] Estimated, see text.

populations on the Great Lakes continue to be their potential impacts on fisheries, "self-inflicted" impacts on their own nesting habitat (especially trees and shrubs), and impacts on sympatrically nesting species (especially various herons) (Weseloh *et al.* 2002).

Prior to the last issue of *Bird Trends* that dealt with Great Lakes–wide populations of colonial waterbirds (1996), the only sanctioned management of Double-crested Cormorant populations that had occurred in the Great Lakes–St. Lawrence basin within the last 20 years was the cull that took place in the Rivière-du-Loup – Baie Comeau area of the St. Lawrence estuary (Bedard *et al.* 1995). Since that time, several management actions towards cormorants have taken place. The purpose of this short paper is to provide an update on the status of cormorants on the lower Great Lakes since the 1996 issue of *Bird Trends*. This includes new information on cormorant nest numbers and known management actions for cormorants on the lower Great Lakes.

Lake Ontario and the upper St. Lawrence River

There have been more than 10 sanctioned or unsanctioned management activities aimed towards Double-crested Cormorants on the lower Great Lakes since the St. Lawrence estuary cull. In 1999, the New York State Department of Environmental Conservation introduced a well thought out, widely reviewed plan to limit cormorant breeding on their waters of Lake Ontario to only Little Galloo Island and to reduce the numbers breeding there. This was done to protect other species that nested with cormorants, primarily Black-crowned Night-Herons (*Nycticorax nycticorax*). This meant that cormorant nesting on Gull, Bass, and Calf islands, located in the Sackett's–Henderson harbours area, would be thwarted and that eggs in nests on Little Galloo Island would be oiled to reduce productivity and the number of nesting birds. Although this program started in 1999, intensive studies of the food habits of cormorants on Little Galloo Island (and frequent visits to the island) had begun a couple of years earlier. Disturbance associated with food pellet collections and the egg oiling reduced nest numbers by more than 52%, from 8410 in 1996 to 3967 in 2004 (Farquhar *et al.* 2003; J.F. Farquhar, unpubl. data).

Although the permit to conduct the oiling of Double-crested Cormorant eggs at Little Galloo Island and the nest dislodgement at the other three sites was for the protection of herons, much effort had gone into attempting to show the cormorant impact on the fisheries of southeastern Lake Ontario (NYSDEC 1999; Ross and Johnson 1999); that work was reviewed by Wires *et al.* (2001). In spite of declining numbers of cormorants breeding on Little Galloo Island, a large unauthorized kill involving hundreds of Double-crested Cormorants occurred there in 1998 (Weseloh *et al.* 2003).

In 2000, the Ontario Ministry of Natural Resources began a 5-year study to assess the impacts of cormorants on the fisheries, mainly in Lake Huron, but with an ancillary study in Lake Ontario. These studies involved intensive assessments of cormorant and fish populations in Georgian Bay and the North Channel through electro-fishing, hydro-acoustic surveys, aerial cormorant surveys, and 3 years of experimental oiling of cormorant eggs in portions of those areas (M. Ridgeway and J. Casselman, unpubl. data). In Lake Ontario, studies focused mainly on fish surveys in the Kingston Basin and near cormorant colonies (A.

Mathers, pers. comm.). Although there were no lake-wide management actions directed at cormorant population reduction at this time, several owners of Lake Ontario islands where cormorants were roosting (and would eventually start to nest) requested and received permission to protect their land interests by harassing cormorants off their land through shooting. These sites included Goose and Glen islands in the Bay of Quinte and East Brothers Island near Kingston (A. Mathers, pers. comm.; DVW, pers. obs.). At Pigeon Island, 16 km southwest of Kingston, Ontario, there have been at least two incidents of unauthorized cormorant control. In 1994, Ewins and Weseloh (1994) estimated the impacts of a shooting event on a colony of cormorants in eastern Lake Ontario. In 2002, two raccoons (*Procyon lotor*) were discovered on this small island. It is highly unlikely that these animals arrived on the island naturally, as it is more than 5 km from the nearest point of land. Presumably, unknown individuals placed them on the island. The raccoons destroyed not only all the contents from several hundred cormorant nests on the island, but also all contents from approximately 90 Herring Gull (*Larus argentatus*) and 8 Great Black-backed Gull (*L. marinus*) nests on the island (CP, pers. obs.).

In 2003, in north-central Lake Ontario, management action was directed at nesting cormorants on High Bluff and Gull islands at Presqu'Ile Provincial Park (Brighton, Ontario). Cormorant nest numbers on the two islands had grown from fewer than 2500 in 1992 to over 12 000 in 2002. It was felt that their numbers were impinging on park values, which included maintenance of habitat for nesting by three heron species: Black-crowned Night-Herons, Great Egret (*Ardea alba*), and Great Blue Herons (*A. herodias*), breeding and migrating woodland bird species, and migrating monarch butterflies (*Danaus plexippus*). In 2003, over 28 000 eggs were oiled in ground nests on both islands, and nearly 4000 cormorant tree nests were dislodged with forestry poles during the incubation period. In 2004, more aggressive actions were taken: 6030 adult birds were culled on their nests during a portion (6 May to 7 June) of the incubation period. In addition, 26 000 eggs in ground nests were oiled and 2000 tree nests were dislodged (Ontario Parks 2005).

Lake Erie and the Detroit and Niagara rivers

On Lake Erie, there have not been any sanctioned or unsanctioned cormorant management actions of which we are aware. A large series of birds (approximately 300) was collected in western Lake Erie in 1997 by staff from the U.S. Geological Survey, but this was for a food habits study (Bur *et al.* 1999) and not conducted as a management action. Cormorant populations on Lake Erie continued to grow, especially on the large islands in the western basin. In 2004, both East Sister and Middle islands held over 6000 cormorant nests. Nest numbers on West Sister Island increased from 2200 in 2000 to 3700 in 2004 (M. Shieldcastle, pers. comm.). Cormorants have also started to nest on Middle Sister Island; there were 20 nests present in 1999, the first year of known nesting, and this had grown to 334 nests in 2004. Vegetation destruction, associated with large and increased numbers of cormorant nests, is perhaps most advanced on East Sister and Middle islands (Crins and Oldham 2000; Hebert *et al.* 2005; Kirk undated). Many large hackberry (*Celtis occidentalis*) trees have died and fallen, many branches have fallen from trees still standing, much of the native herbaceous ground cover has died, and there are large barren ground patches at many locations throughout the forested islands. The Carolinian forest on these islands is rapidly being lost and replaced by invasive species, such as pokeweed (*Phytolacca americana*), garlic mustard (*Alliaria petiolata*), and common goosefoot (*Chenopodium alba*) (Crins and Oldham 2000).

Changes in the Great Lakes cormorant populations since 1996 have been partially documented in other papers and by other authors (Weseloh *et al.* 2002, 2003; Havelka and Weseloh 2004; Hebert *et al.* 2005). Briefly, the population on the St. Lawrence River grew from a minimum of 431 nests (pairs)

at 3 colonies in 1996 to nearly 2700 nests at 15 colonies in 2004 — an average annual growth rate of 25.7%. On Lake Ontario, nest numbers increased from 17 000 at 17 colonies in 1996 to 26 200 nests at 24 colonies in 2004 — an average annual growth rate of 5.5%. On the Niagara River, there were only 32 nests in 1996, but that grew to 393 nests in 2004 (36.8% growth per year). On Lake Erie, in 1996, there were approximately 7200 nests at 6 colonies (interpolated from 5600 and 8900 known nests at 9 sites in 1995 and 1997, respectively). The 2004 total for the lake was 18 900 on 10 sites (a 12.9% increase per year). There are no known cormorant colonies on the Detroit River.

On Lake Ontario, where management actions have been most intensive, it is worth examining the cormorant population numbers in more detail. Lake-wide cormorant nest numbers have increased each year between 1996 and 2004 (range = 4.1 to 21.4% per year) except for 1997 (-4.6%) and 2003 (-14.3%). This is in spite of a 52.8% decline at Little Galloo Island over that period. It would appear that most of the decline in cormorant numbers at Little Galloo Island is merely resulting from dispersal to other areas of Lake Ontario. Similarly, the decline between 2002 and 2003 is accounted for mostly by the decline in numbers at Gull and High Bluff islands, where management activities (i.e., poling of nests in 2003) were very aggressive. However, from 2003 to 2004, in spite of a reduction of 1800 nests at Gull and High Bluff islands, the lake-wide population still increased by 8.3%. The net result of the declining cormorant numbers at Little Galloo Island, in Lake Ontario's eastern basin, and at Gull and High Bluff islands, in the central basin, is that the cormorant population nesting in Lake Ontario's western basin is now growing faster and is more numerous than that in any other section of the lake.

In summary, since 1996, two major management actions against cormorants have been initiated in Lake Ontario, one in the southeastern portion of the lake (in New York waters) and a second in the north-central portion of the lake (at Presqu'Ile Provincial Park). Both actions have greatly reduced the number of cormorant nests in their respective areas. However, with these two exceptions, there has been a steady annual increase in the number of cormorant nests on Lake Ontario. The population stood at 26 000+ nests (pairs) in 2004. On Lake Erie, where there have been no sanctioned cormorant management actions, and for years where the data are complete, the number of breeding cormorants has shown a steady increase each year from 1996 to 2004. There were nearly 19 000 nests in 2004.

Acknowledgements

Bruce Pollard, Don Tyerman, and Donna Stewart commented on an earlier version of this paper.

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B.C. Coastal Waterbird Survey and B.C. Beached Bird Survey

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The B.C. Coastal Waterbird Survey is a volunteer survey designed to monitor all waterbirds on the B.C. coast. The program began in 1999 and is run by Bird Studies Canada, a non-profit conservation organization, with direction from the Canadian Wildlife Service.

Volunteers are given a protocol to guide their counting effort. Guidelines are meant to encourage consistency among counters, waterbird counts, and survey sites. Volunteers go out once a month (second Sunday of every month) to count waterbirds along a specific section of beach or shoreline. Surveys officially begin in September and run until April, but some volunteers also continue throughout the summer. Observers record waterbirds in three distance categories: out to 500 m from the high tide line (onshore), past 500 m (offshore), and inland (inland). There are 260 sites along the B.C. coast, with most sites situated in the Strait of Georgia.

A review of the data in year 3 determined that the survey design provides sufficient power to detect, over a 10 year period, a 20–30% change in the population of 60–80% of the species counted in the surveys. Generally, the most numerous species reported include Dunlin, American Wigeon, Glaucous-winged Gull, Surf Scoter, Northern Pintail, Mallard, and Mew Gull. Rarer species reported include American Bittern, Black-footed Albatross, Cassin's Auklet, Golden Eagle, Red Phalarope, Marbled Godwit, Yellow-billed Loon, Cinnamon Teal, Sora, and American Avocet.

The goal of the B.C. Beached Bird Survey is to establish baseline data on the incidence of mortality due to chronic oiling. This survey, begun in 2002, continues 6 years of surveys conducted in the early 1990s by Alan Burger of the University of Victoria. Once a month (one day in the last week of each month from August to April), volunteers in several communities survey beaches at 67 sites in British Columbia, including 22 sites along the west coast of Vancouver Island and the north coast of British Columbia. In each survey, volunteers walk a specific stretch of beach, recording numbers of beached birds and examining birds for evidence of oil.

Survey data are being used in a joint project of the Canadian Wildlife Service, Fisheries and Oceans Canada, and the University of Victoria to examine the impact of chronic oiling of birds and to develop a spatial risk model for oiling of birds.

Volunteer science opportunities for bird enthusiasts

To develop effective bird conservation programs, scientists require information to determine the status of bird populations as well as the underlying causes of population change. This information includes distribution, population trends, migration pathways, ecology, nesting phenology, and vital rates (productivity and mortality). A significant number of these data are acquired through the efforts of dedicated volunteer "citizen scientists." Many programs rely on volunteer bird enthusiasts of all skill levels: some activities require a high level of skill, whereas for others a simple willingness to learn "on the job" is sufficient. There are many opportunities to participate, and there are local, regional, and national programs available to suit any person's physical ability, level of knowledge, and amount of free time.

Project FeederWatch

Since 1987, Project FeederWatch has been collecting data on winter populations of birds. A great aspect of Project FeederWatch is that it allows even casual birdwatchers to participate in serious ornithological study, contributing long-term data on winter bird populations throughout North America. Analysis of these data can detect significant population declines, track the dynamic movements of nomadic and irruptive species during the winter months, and identify habitat features — including types of feeders and feed — that attract birds. It is also a valuable source of population data for some species not well covered by the Christmas Bird Count. Participants receive direct feedback in the form of a newsletter, and the general public can access the data regarding bird population trends at the FeederWatch website (http://www.bsc-eoc.org/national/pfw.html).

One popular result of the program is the book of results from the first 10 years of Project FeederWatch ("Birds at Your Feeder" by E.H. Dunn and D.L. Tessaglia-Hymes, W.W. Norton and Co., New York, ISBN 0-393-32231-9). It not only describes the food preferences and feeding habits of winter birds but also contains interesting anecdotes and biological notes on the bird species included.

Minimum skill level: Novice (able to recognize common birds by sight).
Time required: One day a week from the middle of November to early April.
Contact: The Project FeederWatch Coordinator, Bird Studies Canada, P.O. Box 160, Port Rowan, ON N0E 1M0, Telephone: 519-586-3531, Fax: 519-586-3532, E-mail: pfw@bsc-eoc.org.

Christmas Bird Count

The Christmas Bird Count is currently the best available multispecies, broad-scale survey of the winter distribution of birds. On one day every winter, between 14 December and 5 January, bird and nature clubs across North America organize a local Christmas Bird Count. Each local group of birders selects a 24-km-diameter circle in their area and does its best to count all the birds within it on that day. Local rivalries and the long history of the count (annually since 1900) have made it one of the biggest social and sporting events in the birding world. More importantly for bird conservation, however, is the huge database on the distribution and numbers of North American birds that the Christmas Bird Count has amassed. The data complement those from the Breeding Bird Survey and are particularly important in estimating population levels and trends for northern Canadian and Arctic bird species whose breeding range lies north of the majority of Breeding Bird Survey routes.

Minimum skill level: Novice; provides a good learning opportunity by teaming with experienced birders.
Time required: One day per year.
Contact: Canadian Christmas Bird Count Coordinator, Dick Cannings, RR#1, S.11, C.96, Naramata, BC V0H 1N0, Telephone: 250-496-4049, E-mail: dickcannings@shaw.ca or contact your local nature or bird club.

Project NestWatch and regional Nest Record Schemes

Project NestWatch and the regional Nest Record Schemes are designed to provide data on the health of bird populations through long-term monitoring of nesting activity across Canada. Data gathered from these projects provide valuable information on the state of the wider environment, because birds are good indicators of the health of the habitat they occupy.

To participate in Project NestWatch or a Nest Record Scheme, you need to find a bird's nest, follow it through the nesting season, and report your observations. Although data on all bird species are desired, Project NestWatch is particularly keen to get observations on common species, to ensure large enough sample sizes for statistical analysis. The American Robin *Turdus migratorius* has been chosen as a focal species because it occurs across most of Canada, individuals and their nests are fairly easy to identify and find (enabling beginning birders to participate), and the species is tolerant of people observing their nests. Robins nest in city backyards as well as in the wider countryside, so if you live anywhere south of the tree line, you can find a robin's nest and join the project (other bird species welcomed, too!).

Minimum skill level: Novice.
Time required: Variable: a few minutes to several hours over the course of the nesting season.
Contact: Bird Studies Canada has a list of local NestWatch coordinators on its website (see: http://www.bsc-eoc.org/volunteer/index.jsp?lang=EN) or you can phone or write Bird Studies Canada at Bird Studies Canada/Études d'Oiseaux Canada, P.O. Box 160, Port Rowan, ON N0E 1M0, Telephone: 1-888-448-BIRD (1-888-448-2473), Fax: 519-586-3532, E-mail: generalinfo@bsc-eoc.org. Regional Nest Record Scheme coordinators can be found by contacting your regional office of the Canadian Wildlife Service (see http://www.cws-scf.ec.gc.ca/index_e.cfm for a list and contact information).

Monitoring Avian Productivity and Survivorship (MAPS) Program

The Monitoring Avian Productivity and Survivorship (MAPS) Program is a program of constant-effort mist netting and banding at a continent-wide network of monitoring stations staffed by both professional biologists and trained volunteers. The program is organized to fulfil three goals: monitoring, research, and management.

Specific monitoring goals: Provide, for over 100 target species, indices and estimates of adult population size and post-fledging productivity; adult survival rates, proportion of residents, and recruitment into the adult population.

Specific research goals: Identify and describe temporal patterns in the above indices and estimates at a variety of spatial scales; determine relationships between these patterns and ecological characteristics or population trends of the target species, habitat characteristics, and weather variables.

Specific management goals: Use the patterns and relationships to determine the demographic causes of population change to suggest management actions and conservation strategies to reverse declines and maintain populations; and evaluate the effectiveness of management and conservation efforts.

Minimum skill level: Novice. Training and manual dexterity are needed to extract birds from nets.
Time required: One day in each of six or seven 10-day periods in late spring and summer.
Contact: Monitoring Avian Productivity and Survivorship (MAPS), National Bird Banding Office, National Wildlife Research Centre, Canadian Wildlife Service, Carleton University, Ottawa, ON K1A 0H3, Telephone: 613-998-0524, Fax: 613-998-0458, E-mail: bbo_cws@ec.gc.ca.

Nocturnal Owl Monitoring

Information on distribution, abundance, and population trends of all North American nocturnal owl species is required to identify species in need of conservation action, develop conservation strategies, and evaluate the effectiveness of current management programs. Most species of nocturnal owls are poorly monitored by existing multispecies surveys, such as the Breeding Bird Survey, Migration Monitoring, and Christmas Bird Count; this program is designed to address this gap.

By playing recorded owl calls at stations along a route, volunteers document the range and status of several owl species in North America. They also record the habitat characteristics so that the results can also be used to determine habitat associations across the range of each species.

Minimum skill level: Intermediate. You should be able to recognize owl calls of the species expected in your area.
Time required: One night per year.
Contact: Bird Studies Canada has a list of local Nocturnal Owl Monitoring coordinators on its website (see http://www.bsc-eoc.org/national/nationalowls.html), or you can phone or write the national coordinator, Debbie Badzinski, at Bird Studies Canada/Études d'Oiseaux Canada, P.O. Box 160, Port Rowan, ON N0E 1M0, Telephone: 1-888-448-BIRD (1-888-448-2473), Fax: 519-586-3532, E-mail: dbadzinski@bsc-eoc.org.

Migration Monitoring Network

Many bird observatories have been established across Canada, some at migration hotspots, to estimate the numbers of birds and record the species flying past during the fall and spring migration seasons. Volunteers can help by mist-netting birds, identifying and banding them, or simply holding the pen and recording the data. Participating is also a great way to learn from experienced birders about common migrants and is an opportunity to hold birds and to see them up close. Once in a while you can be really lucky and be present when a rare species is banded. If you find you're having trouble with your fall warblers, this is also a great way to improve your recognition skills. Training is almost always provided on-site, so anyone with an interest can participate.

Minimum skill level: Novice to intermediate.
Time required: Flexible, determined by interest level, need, and time available.
Contact: Bird Studies Canada has a list of local bird observatories on its website (see http://www.bsc-eoc.org/national/cmmn.html), or you can phone or write Bird Studies Canada at Bird Studies Canada/Études d'Oiseaux Canada, P.O. Box 160, Port Rowan, ON N0E 1M0, Telephone: 1-888-448-BIRD (1-888-448-2473), Fax: 519-586-3532, E-mail: generalinfo@bsc-eoc.org.

Hawk Migration Counts

The Hawk Migration Association of North America's goal is to advance the knowledge of raptor migration across continents, to help establish scientific bases for future monitoring of raptor populations, and to provide, through the use of standard reporting forms and procedures, a data bank on migrations for the use of professional and amateur ornithologists. Its website (http://www.hmana.org/) contains links to many hawk count stations in Canada, which you can contact directly.

Minimum skill level: Intermediate to experienced. You should be able to identify hawks from a distance.
Time required: Flexible.
Contact: See http://www.hmana.org/ for a list of count sites and local contact information.

Breeding Bird Survey

The Breeding Bird Survey is the core source of data for breeding songbird population trends in Canada. Its sampling methods allow statistical analysis of the data, and trends can be tied to specific breeding populations. Conservation plans and projects, from local to international, are based in large part on the results of Breeding Bird Surveys since 1968. Participants drive routes that consist of 50 stops along about 40 km of roadway through a range of habitats. Participants record the total number of individual bird species heard or seen during a 3-minute

observation period at each stop. In Canada, participants run their routes between 28 May and 7 July, but usually during the peak breeding season — the first 2 weeks of June. Participants are also expected to continue their routes for a number of years, so that statistical analyses can be calculated from their results. Workshops, seminars, and training are available to help volunteers retain or sharpen their skills, incentive programs encourage participation, and tax credits for incurred costs are available. For more information, see http://www.cws-scf.ec.gc.ca/nwrc-cnrf/default.asp?lang=en&n=416B57CA.

Minimum skill level: Experienced. You must be able to name birds seen and heard and to be able to pick out individual songs from a chorus. The training opportunities are not intended to teach all the skills required, but to hone specific skills.
Time required: One day per year in the spring.
Contact: Connie Downes, National Coordinator, National Wildlife Research Centre, Canadian Wildlife Service, Environment Canada, Carleton University, Ottawa, ON K1A 0H3, Telephone: 613-998-0490, E-mail: connie.downes@ec.gc.ca or contact your local coordinator from the list at http://www.cws-scf.ec.gc.ca/nwrc-cnrf/default.asp?lang=en&n=C6E31C35.

Regional programs

Every province, territory, or region of Canada has birding programs specific to that area. Examples include checklists, such as Étude des populations d'oiseaux du Québec (EPOQ), which are used primarily to catalogue bird distribution but can also gather evidence of population size variation. Monitoring programs with specific goals, such as the Forest Bird Monitoring Program (FBMP) in Ontario, are cataloguing the changes in bird communities in specific habitats, whereas the coastal Beached Bird Surveys are looking for evidence of damage to marine habitats and its effect on sea ducks and marine waterbirds. A sampling of such programs is listed below, along with contact information. Do, however, visit your local bird or nature club or contact your regional Canadian Wildlife Service office to find out more (see http://www.cws-scf.ec.gc.ca/index_e.cfm for a list and contact information).

Yukon

Yukon Bird Checklist, The Yukon Bird Club, Box 31054, Whitehorse, YT Y1A 5P7, E-mail: ybc@yknet.yk.ca, Website: http://www.yukonweb.com/community/ybc/

Northwest Territories and Nunavut

NWT/Nunavut Bird Checklist Survey, Canadian Wildlife Service, Suite 301, 5204–50th Avenue, Yellowknife, NT X1A 1E2, Telephone: 867-669-4771, Fax: 867-873-8185, E-mail: NWTChecklist@ec.gc.ca, Website: http://www.mb.ec.gc.ca/nature/migratorybirds/nwtbcs/index.en.html

British Columbia

British Columbia Beached Bird Survey, British Columbia Coastal Waterbird Survey, Peter Davidson, B.C. Projects Coordinator, Bird Studies Canada, 5421 Robertson Road, RR #1, Delta, BC V4K 3N2, Telephone: 604-940-4696, Fax: 604-946-7022, Toll-free: 1-877-349-2473, E-mail: pdavidson@bsc-eoc.org. For more information, refer to the article in this newsletter.

Alberta

Alberta Birdlist (Checklist) Project, Prairie Nest Record Scheme, Federation of Alberta Naturalists, 11759 – Groat Road, Edmonton, AB T5M 3K6, Telephone: 780-427-8124, E-mail: info@fanweb.ca, Website: http://www.fanweb.ca/

Canada Warbler Project, Northern Saw-whet Owl Monitoring, MAPS, Amy Wotton, Manager, Lesser Slave Lake Bird Observatory, Box 1076, Slave Lake, AB T0G 2A0, Telephone: 780-849-7117, Cell: 780-849-1702, Fax: 780-849-7122, E-mail: birds@lslbo.org, Website: http://www.lslbo.org

Northern Saw-whet Owl Volunteer Nestbox Program, Northern Saw-whet Owl Migration Monitoring Program, MAPS, Beaverhill Bird Observatory, P.O. Box 1418, Edmonton, AB T5J 2N5, E-mail: Lisa@beaverhillbirds.com, charles@ualberta.ca, Geoffrey.Holroyd@ec.gc.ca, Website: http://www.beaverhillbirds.com

Northern Saw-whet Owl Monitoring, MAPS, Calgary Bird Banding Society, 3426 Lane Crescent SW, Calgary, AB T3E 5X2, E-mail: northern bentbill@telus.net

Manitoba

Northern Saw-Whet Owl Monitoring, Delta Marsh Bird Observatory, E-mail: hdenhaan@cc.umanitoba.ca, Website: http://www.dmbo.org/

Ontario

Ontario Forest Bird Monitoring Program, Canadian Wildlife Service, 335 River Road, Ottawa, ON K1A 0H3, Telephone: 1-866-900-7100; E-mail: fbmp@ec.gc.ca, Website: http://www.on.ec.gc.ca/wildlife/wildspace/project.cfm?HoldID=119&Lang=e?]

Quebec

Étude des Populations d'Oiseaux du Québec (ÉPOQ), 4545 Av. Pierre-de-Coubertin, C.P. 1000, Succ. M, Montréal, QC H1V 3R2, Telephone: 1-866-583-4846, E-mail: epoq@quebecoiseaux.org; Website: http://www.quebecoiseaux.org/epoq/index.htm?]

Maritime provinces

Maritimes Shorebird Survey, Peter Hicklin, Canadian Wildlife Service, Atlantic Region, P.O. Box 6227, Sackville, NB E4L 1G6, Telephone: 506-364-5042, Fax: 506-364-5062, E-mail: Peter.Hicklin@ec.gc.ca

New Brunswick Forest Hawk and Woodpecker Survey, Bicknell's Thrush and Other High Elevation Birds Survey, Beached Bird Survey, Becky Whittam, Atlantic Canada Program Manager, Bird Studies Canada – Atlantic Region, P.O. Box 6227, Sackville, NB E4L 1G6, Telephone: 506-364-5047, Fax: 506-364-5062, E-mail: becky.whittam@ec.gc.ca

Newfoundland and Labrador

Newfoundland and Labrador Shorebird Survey, 6 Bruce Street, Mount Pearl, NL A1N 4T3, Telephone: 709-772-5585, E-mail: cws.nf&lab@ec.gc.ca

Through any of the other volunteers participating in the programs listed above, you are sure to find out about other opportunities to use your birding skills for the benefit of birds in Canada and North America. By birding, you increase your own knowledge of birds and their behaviours; by contributing to one of these programs while birding, you also increase our common knowledge of birds and help to preserve them.

Bird Trends is published for free distribution by the Canadian Wildlife Service. To save resources, please help us maintain a current mailing list. *Bird Trends* aims to provide:

- feedback to volunteers of ornithological surveys;
- information on trends in Canadian bird populations;
- a menu of volunteer-based ornithological projects in Canada.

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The views expressed in this report are those of the authors and should not necessarily be attributed to the Canadian Wildlife Service or Environment Canada.

Cette publication est également disponible en français sous le titre *Tendances chez les oiseaux.*

ISSN 1185-5967

ISSN 1918-9257 (online)

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